THE INDUSTRIES OF JAPAN

W. M. Johnstone
Yacht Normania

THE

INDUSTRIES OF JAPAN.

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LACQUER PATTERN

Autumnal Landscape by Moonlight.

THE

INDUSTRIES OF JAPAN.

TOGETHER WITH

AN ACCOUNT OF ITS AGRICULTURE, FORESTRY, ARTS, AND COMMERCE.

From Travels and Researches undertaken at the Cost of the Prussian Government.

BY

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WITH FORTY-FOUR ILLUSTRATIONS AND THREE MAPS.

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PREFACE.

In publishing these results of many years of study, I hope to afford welcome information and instruction to educated readers of all callings regarding many questions as to the state of civilization in Japan and the industrial activity of its inhabitants. The rich literature upon this land and people has either not touched at all upon many matters which are here thoroughly treated, or at least in such a way that the scientific and technical side has received scant justice. This circumstance, and various others, inclined me, during my stay in Japan, to extend my observations and studies to regions that did not come directly within the sphere of my undertakings. Still I do not fear that competent judges will find, on that account, any want of devotion and thoroughness in the sections on Japanese art-industry.

It is very true, however, that with the wide range which I allowed myself, very considerable difficulties arose, especially when it came to working up and completing in Europe the impressions and results obtained in Japan. That this is so, and how it is so, will best be seen in the separate chapters themselves.

In what has been said I have already indicated the chief reason why this work is so late in appearing. It is now more than five years since the publication of the first volume, and two and a half years since its English edition, although since my return from Japan I have dedicated to the task the greater part of the time and strength left me by the duties of my profession.

With the satisfaction of having tilled for the first time a field that was yet for the most part uncultivated, I unite the less agreeable consciousness that all I can offer is only patchwork, notwithstanding all my care and labour. From the fulness and uncommon importance of the material, it was not possible to treat all subjects at equal length. It cannot but be that the reader, according to his standpoint and interest, will find one too briefly handled, and another perhaps too fully discussed. The numerous Japanese names, which may be valueless to many in Europe, or even in their way, will be a welcome means of guidance to foreigners and natives in Japan.

In the introductory chapter on Japanese art-industry I have merely touched upon painting and the history of its development. I was aware that my judgment and my knowledge in this department were far inferior to those of a scholar who had devoted six years in Japan itself, and much more time since his return to England, to this subject and the preparation of a work upon it. The results of his studies are now appearing in a sumptuous volume under the title, "The Pictorial Arts of Japan," by William Anderson (Sampson Low & Co., London). This book not only fills the gap left by me, but offers to every friend of art the first thorough instruction in the character and development of Japanese painting.

It remains for me to express my thanks to several friends for their kind assistance. Professor Dr. Justi, of Marburg, furnished, after originals, the excellent pen-and-ink drawings for the woodcuts figs. 1 (12), 13, 16, 17, 18, and 19. To my talented scholar Herr C. Schulteis I owe the drawings for figs. 8, 9, 10, 11, and 14, and for tables I., II., III., IV., and XV. Herr C. Reinhertz, another of my earnest scholars, drew the review-chart for mining-industry, after a large hand-chart which Engineer Kurimoto, of the "Upper Mining Office" in Tôkio, had kindly sent me. I am indebted to the latter for various other points as well, and also to Dr. S. Nagai, who aided me by reading the proofs for errors in Japanese.

All the illustrations are original, and I acknowledge gratefully the fact that the publisher has spared neither trouble nor expense to worthily adorn the book.

BONN.

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INTRODUCTION.

For three decades, Japan, more than any other Asiatic country, has been attracting, to an ever-increasing extent, the attention and the most widely varied interest of the Western world. Numberless newspaper articles, treatises, and books, as different in contents and value, as in the preparation, fitness, and inclination of their authors, bear witness to this fact. Merchants, artists, and scholars feel attracted in the highest degree by the fair Island-kingdom Nippon, the "Land of the Rising Sun," in the eastern part of the Old World, and by the civilization of its inhabitants and their many interesting productions, both natural and artificial. But even more effective in winning and keeping such sympathies, since the notable occurrences to which the Perry expedition, in 1854, gave the first impulse, has been and is the relation of the government and people of Japan to the advances of Christian civilization. In order to become acquainted with the results of this civilization, and to turn them to account, the Japanese Government invited into the country, from the greatest and foremost lands of Christian culture, educated men as teachers and organizers; while, on the other hand, it sent forth ambitious and talented young men into the West, to complete their education for the good of their fatherland.

Officials in high positions, moreover, have repeatedly appeared among us, with the same intent, and have made it their business to master our principal systems of administration, popular education, and industrial activity. And we have further proofs of the talent and zeal of this surprisingly progressive nation, when we read how here a Japanese won with honour a university degree, and how there another succeeded in chaining the attention of our German savants by a scientific discourse; how Japan has distinguished herself by noteworthy contributions to the different national exhibitions of modern times, while opening at home her first railway, in the planning and building of which no foreign engineer participated. But Government and people have won a still greater victory in matters of religion. They have at last exchanged their old prejudices and hatreds, and the severe ban against Christianity, for full religious liberty, which cannot fail to exert a favourable influence upon the spread of Christian teaching.

With the restoration of the Mikado to power in 1868, the whole feudal system went to pieces. The Daimiôs, partly of their own accord, and partly because compelled by the new Government, deserted their strongholds, many of which, in this transition period, fell a prey to destruction, so that their ruins, like many with us, stand gazing out upon the world, the speechless memorials of a differently constituted age. A similar fate threatens the Buddhist temples and cloisters. For with the reorganized administration there entered a new spirit, a breath of that Christian civilization, whose results have already been briefly hinted at. The religious freedom recently proclaimed is one more natural stride in this direction in which that Asiatic land and people, farthest from us in space, have drawn nearer to us in spirit than any other has ever been. In view of all these phenomena, Schiller's words are here appropriate :—

> "Das Alte stürzt, es ändert sich die Zeit,
> Und neues Leben blüht aus den Ruinen."

Old Japan found its ideal in China, in Chinese contributions to political, industrial, and intellectual affairs ; new Japan seeks its ideal in the Christian countries of the West. It has been shown, or at least indicated, in the first volume of this work,[1] that the Japanese are a peculiar branch of the great Mongolian family, in physical appearance, language, and characteristic traits of mind ; and that they belonged to the Chinese system of civilization, and received the impulses to all their social, agricultural, and industrial development from China, principally by way of Corea.

The introduction of Buddhism and of Chinese philosophy, particularly the teachings of Confucius, were therein also considered, as mediums of this peculiar civilization. While this philosophy fostered caste-spirit, feudalism, and ancestor-worship, Buddhism especially influenced the industrial population, exerted a softening effect upon manners, and trained up peaceable, quiet labourers in field and workshop. The noteworthy performances of the Japanese in these two departments of labour, and the increasing influence of their productions upon our own affairs, will be fully brought to view in the following chapters. For the history and ethnography of the Japanese people, as well as for the natural history of the land, and its geographical relations, the reader is again referred to the first volume of this work, which, at the time of its publication, I designated as a preliminary study towards the better understanding of the various phenomena of industrial life.

[1] Title of Vol. i., as published in English : "Rein's Japan : Travels and Researches." London : Hodder and Stoughton, 1884.

AGRICULTURE AND FORESTRY.

AGRICULTURAL INDUSTRIES.

I.

"Nihil est agricultura melius, nihil uberius, nihil dulcius, nihil homine libero dignius."—Cic. de Off., lib. I.

AGRICULTURE AND FORESTRY. AGRICULTURAL INDUSTRIES.

1. Japanese Agriculture in General.

Possession and Taxation.—Area and Division of Cultivated Lands. — Climate and Soil.— Efforts of the Government to elevate Agriculture.—The Kaitakushi, or Colonial-office.—Fertilization and Preparation of the Soil.— Terrace-culture.— Planting in Rows.

In contrast with the nomadic races of Central Asia, the inhabitants of the monsoon region have for thousands of years been tied to the soil. They are intensely devoted to agriculture, especially in China and Japan. Little opportunity is left in these countries for cattle-raising; and since meadows and pastures are wanting, milk, butter, and cheese—the principal food of the nomadic Mongolian peoples—were unknown to the Chinese and Japanese. Eggs, and the products of fishing and the chase, play a far more important *rôle* than the flesh of domestic animals, which is not eaten by many millions. Since sheep were but seldom found in China, and not at all in Corea or Japan, wool was formerly of small consideration in the matter of clothing. Hemp and cotton goods, and silk among the rich, especially in the winter, are the stuffs with which the population is clothed.

In the countries of Chinese civilization, the dwelling is a more or less solid house, built of wood or bamboo-cane, and roofed with straw, shingles, or tiles. It is airy and pleasant in summer, but less comfortable in winter, when the occupants exercise their skill in protecting themselves against cold by the increased quantity and better selection of their clothing, rather than by solid walls and suitable heating apparatus. In internal arrangement, the dwellings of the Chinese, Japanese, and Coreans differ very considerably from one another. Common to them all, however, is the use of bark-paper for window-panes. From the reports of travellers in Central Asia, it appears that there too, as in the monsoon region, glass panes are not used, but that the paper pane over the window frame or swinging door has penetrated even into Zungaria, without having been adopted by other peoples.

As Tokugawa Iyeyasu, the founder of the last Shôgun dynasty, emphasizes in the twelfth of his "Eighteen Laws," the introduction of agriculture into Japan is to be ascribed to the sun-goddess *Tenshô Daijin* (Amaterasu). She was, to the old Japanese, Janus and Ceres in one. Her temple at Yamada, in Ise, was the great national sanctuary, which had to be cared for according to law, and built anew every twenty-one years out of consecrated Hinoki-wood (*Chamæcyparis obtusa*, S. and Z.), "in order that the land might have peace, and the Gokoku thrive." By Gokoku (five chief cereals) were meant rice, barley and wheat, Italian millet, other kinds of millet, and beans—in fact, the principal *Kokurui*, that is, cereals and pulse. The term Go-koku, however, did not mean the same in all ages. Thus we find in Kaempfer, "Amœn. exot." p. 834, Kome (*Oryza*), O-mugi (*Hordeum*), Ko-mugi (*Triticum*), Daidsu (*Dolichos soja*, L.) and Adzuki (*Phaseolus radiatus*, L.) mentioned as Gokoku. Later, the idea was extended farther, and included all important food-plants belonging to the group of cereals and pulse.

In this high estimate of the Go-koku they imitated the Chinese, as, in general, Chinese agriculture has been the starting-point and prototype of the Japanese.[1]

The Emperor Shinnung had introduced and spread the practice of agriculture in China, about the year 2700 B.C. For this he was deified after death, and a temple was dedicated to him in Peking. In the park-like surroundings of this temple, the emperor of China since then, at the time of the spring equinox, annually ploughs a piece of land and sows it with go-koku.

The Mikado, it is true, was under no such obligation at the sanctuary of the mother of his race, in Ise; but agriculture was none the less regarded in his realm on that account. The Japanese appreciates the fact that it is the first and best foundation of the prosperity of the population and of the State, being the most necessary and the only sound basis; and he expresses this idea in the saying, "No wa kuni no moto," "Agriculture is the prop of the country." According to the latest census of January 1, 1883, it employed 18,160,213 persons, or about the half of a total population of 37,017,302. And these, moreover, are merely the Hiyakushô, or actual peasants, to whom are to be added from the group of former Samurai, a portion, estimated at many thousands, who have, in recent times, likewise turned their attention to agriculture. Agriculture pays to the State 58 per cent. of its income; or, with the addition of the agricultural industries, as Sake-manufacture, etc., and the tax upon them, as much as 80 per cent.[2]

[1] See Bretschneider: "On the Study and Value of Chinese Botanical Works;" and Williams: "The Middle Kingdom," i. 78.

[2] At the close of the fiscal year which ended June 30, 1884, the total revenue

Among the three classes of the Japanese people (Heimin), the farmer (Hiyakushô) stood higher in rank than the artisan (Shokunin) and merchant (Ahindo). Among the Samurai the occupations of the last two were deemed less honourable, but they did not find it beneath their dignity to till the field like common peasants. They made use of this social freedom, however, only in a few districts, as Satsuma and Tosa, that is, in just those regions which were celebrated for producing the bravest and most intelligent warriors. Maron, in his report on Japanese agriculture,[1] a work that is still worth reading, remarks that, owing to the long isolation of the land, the Government and the nation at large had to yield to the consciousness that bodily existence depended under all circumstances upon the productions of their own lands, and that nothing could make up a possible deficit in the harvest. From this we might argue to an improvement in agriculture at the beginning of the Tokugawa rule; which in fact is well known from the history of Iyeyasu, especially in reference to the plain of Kuwantô.

The development of foreign commerce was in those days completely crippled; and the main working power of the nation was all the more turned to agriculture and kept in that channel. The long period of peace, however, which began with the year 1600 probably had a more far-reaching effect than this fact in determining the character of Japanese agriculture; for, although it had already attained a vigorous growth after the Chinese pattern, it had later retrogressed very considerably on account of the continual civil wars.

According to the old Japanese view, which is based on the tradition and representation of his heavenly descent, and the creation of the Japanese islands by his divine ancestors, Isanagi and Isanami, the Mikado was and is the lord of the whole country, and the only landed proprietor in it. But in reality, the extended mountain forests, as well as all waste and barren land, belonged in later times principally to the feudal lords, and is now the property of the State, while the cultivated soil was owned by the peasant, as hereditary lessee. He was, and is still, what we should call a small farmer, who could inherit his property, let it out to others, increase it by purchase, or transfer it to other hands by sale; but, in any case, he had to see to it that it remained under the traditional system of cultivation and that the taxes reckoned upon that basis were, at the right time, made over to the prescribed authority. By this the right of possession and disposition was, so far, restricted. The taxes upon cultivated soil were in general high, and had to be paid in kind. Apart from this, however, the Japanese

of Japan was 73,943,258 yen. The ground tax paid 43,029,745 of this, and the tax on Saké and similar articles of luxury, 16,768,135 yen (1 yen = 4·3 shillings, about).

[1] See Salviati: "Annalen der Landwirthschaft," vol. xxxix., pp. 35–72.

peasant occupied a much freer position than many of his class in Europe during the Middle Ages, who were far more rigorously oppressed, as Thunberg[1] emphasizes, with villainage and other burdens.

From what has been said, we must infer a great difference in the extent of peasant proprietorship. But larger, and according to our conception, better rounded estates, the so-called *latifundia*, are now altogether wanting. There are no large landed proprietors in Japan, either peasants or nobles. In the most ancient times, as long as the Mikado was still the actual autocrat of land and war, and the various classes of society had not yet been rigidly and by birth separated from one another, the taxation of the peasants was light, for Japanese conditions. Every eight families had to farm for the Mikado a ninth part of the arable land apportioned to, and divided equally among, them, and deliver to the officials its raw products. But as dualism in government and the feudal system under the Shôgunat developed, the number of the unproductive classes of the Samurai, in the widest sense, increased, and with it the amount of taxation upon the peasants, which, particularly in time of war, reached, through arbitrary regulations, a weight that was often crushing. In place of the original feudal relation to the Mikado, sprang up that to the feudal lords. Through all the changes of mastership, the peasants remained bound to the soil, and they are, to this hour, in every respect the most conservative class in Japan. The chief support and power of the country rests in the hands of this industrious, sober, and frugal population, which still cultivates the soil in original simplicity, as it has been accustomed for centuries to do under all kinds of rulers.

About the year 1595 A.D. Taikô-sama (Hideyoshi) reorganized their system of taxation, decreeing that the contribution of raw products should henceforth consist of a third part of the assessed produce of the fields, and should be paid in rice. Iyeyasu made no alteration in this arrangement with reference to his great possessions, but only declared, in the thirty-sixth of his Hundred Laws, that the produce of forests, groves, mountains, and rivers should also be taken into the reckoning.[2]

Thus matters stood until 1716, when the taxation of the lands of the Shôgun was increased to one-half of the assessed produce. In the estates of the Daimiôs, the revenues were by no means everywhere the same. While the peasants under one of these feudal lords were almost crushed by the high land-tax and lived in extreme poverty, the mild, provident rulership of a neighbour was indicated by greater prosperity, by the building of roads and bridges, and many other improvements. But the peasant went about his work in the old-fashioned way, and despite this great

[1] In Åkerbruket : "Resa," iv. pp. 76–92.

[2] Kempermann : "Die Gesetze des Izeyasu," in "Mitth. der deutschen Gesellschaft," etc., i. p. 12.

difference in the burdens of landed property among the various estates, lived quietly and in a docile manner, even when the harvest was short and he had to surrender almost the whole crop, so that he and his family were afterwards dependent upon the master's good-will and store-house.

The arable land was divided into four classes, of which the rice-fields composed the first and most taxable. All returns and revenues were reckoned in koku of rice,[1] and those of the other cereals were reduced to the equivalent in rice. A daimiô of 10,000 koku, accordingly, was a feudal lord whose estate was valued at a total of 10,000 koku of rice, even if a considerable part of this sum was only an equivalent term for other crops. The peasants had to surrender to him after harvest the high fixed percentage (one-third, one-half, or more) ; the rest was their own. This rice-tax, however, went into the storehouse, from which not only the Daimiô and his family, but also the Shôgun, the Samurai and priests received their allotted shares. Ten thousand koku, however, was the revenue of the smallest Daimiô estates, whereas, the largest, for example, Kaga, with the most extended area (next to the Shôgun) was estimated at 1,027,000 koku.

One of the first efforts of the new Government, after the restoration of the Mikado to power, was to introduce a more just and even taxation of landed property, and to substitute money for taxes in kind as a medium of payment. This took place in 1872, by means of a proclamation, for which its originators anticipated great success. But it had the opposite effect upon the peasant class—general discontent and passive resistance against the great innovation, and in the following two years even excited public tumults in eertain provinces. These were, however, soon put down ; and the great dislike to the changes also came gradually to an end among thoughtful people. Nevertheless it is an interesting question, What was the cause of such conduct on the part of a class usually so obedient and subservient? The right answer to it was given in 1873 by Kidô, one of the most prominent and acute of the Mikado's supporters and advisers at the time of the restoration. In a memorandum, in which he criticises sharply the revolution of all things by new laws and ordinances, he writes: "Another evil is, that the laws are repealed without sufficient deliberation. That which was yesterday accounted just, is condemned to-day ; and even before a new statute comes into operation, another follows and partly supersedes it. It must naturally be hard for the people to reconcile all this." A number of regulations, some of them ridiculous in the extreme, had been, in single ken, added to the new and energetic laws, like the revenue reform and the new recruiting act (which made all classes of society liable to military service, hitherto the duty and privilege of the Samurai), and men's

[1] A koku holds 180·4 liters. The value of a koku of rice ranges from 2½ to 5 dollars.

heads were completely turned. It is no wonder then that the peasants looked upon the new revenue system as only increasing their burdens, and accepted it with distrust and ill-will. It was nevertheless carried out, and in the following way.

On the basis of the old division of arable land into rice land (ta) and dry-farming land (hata), and of the supposition that the product of a chô of the former should be reckoned equal to that of 2·6 chô of the latter, the Government, in 1873, taxed not only the value of the average harvest-returns, but also the land-value in the several ken, and determined then to raise 3 per cent. of this basal value as a yearly state tax. The proportion was, on January 4th, 1877, reduced to 2½ per cent. To this general State tax one must now add, however, the district, or ken tax, which varies from ½ to 2½ per cent. of the land value, thus in general corresponding as to its objects to our district and communal tax, and to which also all institutions (theatres, etc.) and persons that serve for the entertainment and pleasure of the public had to contribute.

Liebscher[1] says with reference to this land-tax,—which, while nominally 2½ per cent., is really from 3 to 5 per cent. of the value of the land, when the ken tax is counted in,—that it would be in other countries too high to collect; but that the possession of land means to the Japanese farmer something quite different from what it does to us. "With us, a workman can afford to pay a far higher price or rent, than a rich farmer, for a piece of land, which he can cultivate in his leisure hours, and for whose manuring and working he need be at no care or expense. Thus, too, the soil has a much greater worth to the Japanese peasant than is expressed by the money value of the crops possible for him to get from it, being absolutely necessary for his existence." Nevertheless, the peasant insurrections in quite recent times, with their causes, show that the present method of taxation has its hard features; that the tax cannot be gathered after bad harvests, and may rouse the people to desperation.

According to those investigations and decrees of the Japanese ministry of finance, in 1873, which had reference only to the old O-yashima, the area amounted to:—

Rice land	2,539,090 chô	= 2,518,106 ha.[2]
Dry-farm land	1,732,449 ,,	= 1,718,122 ,,
Total cultivated land . .	4,271,539 chô	= 4,236,228 ha.

The average value of rice land was:—

531·24 yen = 2124·96 marks per chô (or hectare), and that of the hata,
206·72 ,, = 826·88 ,, ,, ,,

The gross product of the average harvest was reckoned at 11·77 per cent. of the selling piece of land = 62·53 yen per chô, for rice

[1] "Japans Landwirthschaftliche Verhältnisse." Jena, 1882.
[2] ha = hectare.

land, and at 11·29 per cent. = 23·37 yen per chô, for dry-farm land. The harvest products of 11·77 per cent. and 11·29 per cent. respectively, of the value of the land were distributed as follows:

	Rice land.			Dry-farm land.	
	per cent.	per chô.		per cent.	per chô.
State tax	2·5	13·28	...	2·5	5·17
Ken tax	2·5	13·28	...	2·5	5·17
Costs of production	2·77	14·72	...	2·29	4·75
Net earnings . . .	4·00	21·25	...	4·00	8·28
	11·77	62·53		11·29	23·37

On this basis, the ground tax for—

2,539,090 chô of rice land comes to . .	33,719,115 yen, and for
1,732,449 chô of dry-farm land comes to	8,956,761 yen; and for both together,
4,271,539 chô of cultivated land comes to	42,675,876 yen.

And 43,029,745 yen was the actual revenue taken in the fiscal year which ended June 30, 1884.

At present the area of Old Japan [1] (Hondo, Kiushiu, Shikoku, Awaji, Sado, Oki, Iki, and Tsushima), comprising 18,537 sq. ri = 28,356,945 sq. chô, is divided as follows:—

1. Uncultivated mountain forests and desert land	17,302,928 sq. chô.
2. Cultivated and useful land, in the broadest sense.	11,054,017 „

The latter embraces—

a. ta, or rice land	2,642,251 sq. chô.
b. hata, or dry fields	1,852,455 „
c. hara in use (for grass, hay, and pasturage)	756,127 „
d. yashiki, or building ground	548,541 „
e. shio-hama (flat sea-shore for salt evaporation)	6,364 „
f. cultivated forests	5,240,571 „
g. artificially made pleasure-grounds . . .	7,708 „
	11,054,017 sq. chô.

The group *b* (hata) embraces also—

the mulberry plantations for silk culture	110,174 sq. chô.
tea-plantations	42,174 „

[1] According to information kindly given by the imperial Japanese embassy at Berlin, with reference to the levies of 1879, and also of Herr Regierungsrath Rudolph.

Also the land devoted exclusively to the paper-mulberry, to the lacquer-tree and the tallow-tree, and to fruit-raising, all of which would come to 60,000 chô; so that from the above 1,852,455 chô, 212,000 chô in round numbers are to be subtracted, and there will remain for agriculture, under *a* and *b*, only about 4,282,000 chô in all, or 15 per cent. of the total area.

If one takes into consideration, moreover, the other island groups, it becomes apparent that only the Riukiu islands, with their 156 sq. ri = 244,026 square chô, are under advanced cultivation; while the great Yezo with the Kuriles = 6,093 square ri = 9,477,280 square chô, has a small amount of agriculture to show. We shall reckon it and the Riukiu high enough in taking the total area of the latter as cultivated land, and adding this to the above 4,282,000 square chô. So then, it turns out that the whole Japanese Empire, with 24,799 square ri = 38,564,345 square chô, has at the most an area of 4,518,500 square chô for the cultivation of field products, that is to say, not quite 12 per cent. of the entire surface. And even in Old Japan, this small proportion sinks in some provinces, as Hida and Inaba, to as little as 5 per cent. and under.

Of the Kuriles, only the most southerly are arable at all, even in streaks and patches; of Yezo, only the alluvial plains of the Ishikari and other rivers in the west and south, not the north and east coasts, which are foggy, and cold even in summer.

In Germany, 41 per cent. of the ground is devoted to agriculture, and 11 per cent. more is meadow-land, for which Japan has no equivalent, since the bottoms of the valleys—with us, especially among the mountains, used for raising grass—are in Japan put under cultivation for rice and similar products. The hara, too, cannot, in an economical sense, be compared with our pastures.

Taking the population of Japan as 37,000,000, and that of the German Empire as 47,000,000, the cultivated arable land of the former as 4,270,000 ha, and of the latter as 22,181,000 ha (41 per cent. of 541,000 square kilometres), we discover that there are in Japan 11·5 Are to the head, against 47·2 to the head in Germany. The cause of this remarkable fact lies partly in the climate and the nature of the soil, partly in the method of farming.

Vegetation—and consequently agriculture also—depends above all upon climate, particularly upon temperature, light, and moisture, and is only secondarily conditioned and modified by the nature of the soil and other circumstances. Now, the climate of Japan, as was minutely explained in the first volume, pp. 120–153,[1] is, in a reduced scale, the same as that of the neighbouring continent and that of the oceanic islands, to a certain extent uniting both. Japan lies under the influence of the monsoons and of the sea, which deflects them somewhat and weakens their effects. Atmospheric depressions,

[1] In addition to that work, the publications, subsequently issued, of E. Knipping, of Tôkio, the highly deserving director of the meteorological observatories in Japan, were made use of.

as a rule, follow the main directions of the islands, from S.W. to N.E. In winter they are frequent, and generally of short duration. The prevailing directions of storms at this season are from W., S., and E. In summer the depressions of the barometer occur more seldom, are slighter, and move more slowly from S. to N., or from S.E. to N.W. Soft winds are accordingly the rule, and storms seldom occur, and then chiefly from the S. and E. In late summer and autumn, the number and rapidity of depressions increase rapidly, their direction changes to S.W., the normal, and several typhoons are developed amid widespread heavy and lasting rains.

These dreaded whirlwinds set in most frequently in September, when the sea-water has reached its highest temperature; and this was the case with both of last year's storms, of which the first was observed on September 15th, and the others on the 17th and 18th.[1]

During the first, on September 15th, 1884, which travelled from S.W. to N.E. over the south-eastern part of Hondo, the barometer sank about 45 mm., down to 705 mm., within $4\frac{1}{2}$ hours, and rose again almost as fast. Apart from these isolated cases, the barometric changes in the course of a year are slight.

In winter the high barometric state of the continent crosses to Japan, and brings heavy winds from the N. and N.W., and a clouded sky with great fall of snow on the side next the Japan Sea, but a clear sky and little snow on the other, the lee side. The transition from the soft, warm, and damp south winds of summer to the rough and relatively dry north monsoon winds of winter is by no means sharp and immediate. Still less so is the reverse process in spring. This vernal and autumnal change in the direction of the winds marks the end and beginning respectively of the two chief divisions of the year, winter and summer. When the south monsoon enters upon its sway in spring (in March or April, according to the latitude), and Japan proper receives its first warm showers, then begins the sowing of summer grain, especially of rice ; and when in September, after heavy rainfalls, the summer is ended, the harvest of most of the crops begins. A relatively high temperature, light winds, great dampness of the air, and frequent rains, which alternate, however, once or oftener with dry spells a week long, characterize the Japanese summer.

October, the general harvest-month, is for the most part dry and clear. The water of the heavy September rains has gradually run off; but above the highest mountain-summits the precipitations of vapour have already acquired a sharp outline, and the white hoods, with many other natural appearances, announce that winter is near. Trees and shrubs in gardens, groves, and forests, display a large share of their autumn garments—a delightful diversity of colours, from the deepest, most brilliant dark green of the ever-

[1] See "Annalen der Hydrographie und Marit. Meteorologie," 1885, pp. 99 ff.

green varieties through all the shades of dull-green, white, yellow, red, and brown of the deciduous sorts. The nights grow colder, till, towards the end of the month, the change of season is quickly concluded with the first frosts, and winter quiet prevails in wood and field. From this time on, most of the trees are bare of leaves, at least in Central and Northern Japan, and the turf appears much duller and more lifeless than with us.

As in all Eastern Asia, so in Japan, winter is the dry season, in which there prevail mostly a clear sky, high pressure and low temperature—the last especially at night, and when the monsoon has been blowing for several days with unusual force. On such days, in January and February, there may appear in Japan, though quite exceptionally, those dust-storms which make winter so disagreeable in China. The light, porous soil is whirled about, the sun loses its lustre and the winter grain in the fields its firm hold. And the thermometer sinks during the night to -9° or -10° Centigrade in Tôkio, and approaches the freezing-point even in the daytime. Night-frosts occur from November till March; and the mean temperature for this winter of five months is only $5{\cdot}5^\circ$ C. This shows that the cold is far too great to admit of vegetable growth, although never very severe, and that therefore the fruits of the field have a long period of rest. The mean temperature from April to October is 20° C., and from June to September, the four hottest months, $23{\cdot}5^\circ$ C. The greatest heat, 34–35° C., comes towards the end of July or in the beginning of August, but does not last long.

From the sea-level to the mountain-tops the elevation is more than 3,000 metres, and the country extends over twenty-seven degrees of latitude, so that there is great diversity of climate. The Bonin-islands and Riukiu (partly of coral structure) in the south approach the tropic of Cancer, while Yezo and the Kuriles are related to Siberia, in situation and climate; and their coasts have cold foggy summers and long winters, in consequence of the above-mentioned polar current. Thus the meteorological observations for 1883 gave a variation in mean temperature between $16{\cdot}7^\circ$ C. in Kagoshima ($31^\circ\ 30'$ N. lat.) and $6{\cdot}5^\circ$ C. in Sapporo ($43^\circ\ 4'$ N. lat.), over a stretch of country as wide as from Lyons to Memel. It is apparent from this, and from observations at the intervening stations, that the mean annual temperature in Japan falls on the average $0{\cdot}9^\circ$ C. for every degree of latitude going north—a relatively rapid change. It is considerably lower than on the same parallels in the west of Europe. For example, the station Nobiru, in latitude 38° on the Pacific, has the same mean annual temperature as Cork and Valentia in Ireland, in latitude 52°. The difference is ascribable to the long winters of Japan, with their relatively low temperatures, on account of which the climate of Japan approaches that of the continent of Asia. Thus Nagasaki, in latitude $32^\circ\ 44'$, has the same mean winter temperature as Montpellier, which lies 11° further north; and Kagoshima, although in the same latitude as Damietta, has frequent night frosts in winter.

January was the coldest month of 1883 in the greater part of Southern Japan (Kiushiu, Shikoku, and the parts of Hondo which border on the Inner Sea and the Owari Bay); but in the rest of Hondo and in Yezo it was February. August proved the hottest almost everywhere. The difference between the mean maximum and the mean minimum temperatures increases naturally with the latitude and with the distance of the station from the coast. It amounted in Miyasaki, for example, to 19° C., and in Sapporo to 28° C. More important, for vegetation at least, are the greatest extremes of 36·6° C. in Wakayama and −22·2° C. in Sapporo. In Kôchi the difference between the highest and lowest temperature amounted to 36° C.; in Sapporo, 56° C. Variations of 14 or 15° C. on the same day and in the same place are not unusual in spring and autumn.

With reference also to the amount and distribution of rainfall, the greatest differences were indicated. The stations in Yezo excepted, Aomori, Nobiru, and those on the Inner Sea recorded the least rain-fall (under 1,000 mm.); Kanazawa, the highest (2,400 mm.); and then followed Kiushiu and Shikoku. During the winter months, the greatest fall is on the north-west and west coasts. The largest amount, for Kiushiu and Shikoku, comes in April, May, and June, while in March, September, and October there is a more equal distribution over the whole country.

In general, however, Japan is blessed with copious rains, especially in summer. These, together with the large amount of snow, which in winter lies everywhere upon the mountains, and, towards the north, on the plains, supply a number of springs. The water supply of the country is therefore copious and is of great aid to vegetation, partly directly and partly through irrigation. Quiet lakes, murmuring brooks, and rushing cascades heighten the charm of the landscape in mountains and forests; but there is not room enough for the development of great river systems and a thorough utilization for commerce.

The long extended row of the Japanese islands, with predominatingly mountainous character and great diversity in relief, is of varying geological structure. This subject has, since my departure from Japan, been thoroughly investigated, especially by Gottsche, Lyman Naumann, and others. The last, particularly, as director of the geological survey, in conjunction with T. Wada, the royal ministerial councillor and director of the Royal Geological Institute, has expended much industry and skill in this department.[1]

In the order of age, there follow upon the original gneiss,—which, however, has been found outcropping only in a few spots,—widespread and often extensive deposits of crystalline shales. Great

[1] See E. Naumann: "Ueber den Bau und die Entstehung der Japanischen Inseln." Berlin, 1885.

masses of mica-, talc-, chlorite-schist, serpentine, and marble,—whose presence on both sides of the Bungo Nada I was the first to prove, and which can be followed through all Shikoku and the peninsula of Yamato,—have been since then found in all parts of the country; but this formation appears to be most extensively developed in Shikoku, where, according to Naumann, it composes the highest peaks.

Then follow, according to age, different strata of clay-shale, greywackè, quartzite and lime-stone, all of which, like the crystalline shales, often exhibit marked faults—and until now, with the exception of the varieties of lime, have yielded no fossil contents, and therefore no data for a nearer determination of their age; so that they must for the present be grouped together as palæozoic strata. The lime-formations exhibit in various localities rich enclosures of Fusulines and other characteristic petrifications, which establish beyond a doubt that they belong to the carboniferous formation.[1]

In 1874, through the discovery of petrifactions in the brown Jurassic formation of the province Kaga, I furnished the first proofs regarding the existence of mesozoic strata, an indication which has been followed by countless others, so that now there is no doubt as to the appearance also of trias and chalk.

Miocene and pliocene conglomerates, sandstone, slate clays, peat, volcanic tufas, and sea-sand, with many fragments of marine shells or a rich land-flora, lie in many places among the older mountain ridges already mentioned, and especially in proximity to the sea, along the coasts and inlets, or in the plains which long ago arose from the ocean itself. Of eocene formations, however, as well as of the diluvian, there has not yet been any certain indication.

The oldest eruptions,—which have in many places broken through the metamorphic and palæontological strata, and overlie them, —were of granite, which is very widespread. For example, in central Hondo (or Honshiu), it forms a large part of the higher mountains; the border range between Shináno and Hida, particularly, being a case in point. In the Komágatake of Kai, the granite reaches a height of 3,000 metres. A great number of other mountains of respectable height are also composed of it, and it underlies many others.

Later volcanic formations with almost greater frequency break through most varied complexes of strata, and in many cases overlie them, as they do the granite. Thus they often compose the tops of peaks, or they appear along the mountain side as isolated advanced outposts, in the usual conical shape. Among these the most prominent is Fuji-san, or Fuji-no-yama. This "mons excelsus et singularis" (Kaempfer) lifts its head (3,750 meters) far

[1] See the first volume of this work, p. 38, and Naumann, pp. 12 ff.

above all other peaks of the land, covered with snow for ten months of the year, and a weather-sign and prognostic for farmers and sailors. It is the most popular mountain in Japan, and the one most visited by pilgrims. It is found reproduced on many works of decorative art.

Hot springs, especially neutral, and sulphur springs, are numerous; and no province is wanting in them. Earthquakes and their accompanying floods, as well as mighty eruptions, with their showers of ashes and streams of lava, have from time to time thrown the country into terror and partly devastated it.

The predominatingly mountainous character of Japan and the peculiar method of farming, with rice as the chief staple, confine agriculture more or less to the plains and the valley bottoms; and this fact accounts for the low percentage of cultivated land. A larger part of the soil is indisputably fit for cultivation, so in Yezo and the north of Hondo and particularly of the Hara, and in many of the glades among the mountain forests; but this amount is not as great as is often maintained. To bring this land under cultivation, however, an altogether different method must be employed, and must go hand-in-hand with the establishment of better means of communication, with the development of cattle-raising,—bringing about, as the latter would, a proper system of manuring,—and with the introduction of a more comprehensive method of management, involving more appropriate appliances and machines, not to mention rotation of crops and many other improvements. All this would completely transform the domestic and business habits of the peasants, and for this reason alone cannot take place in a day, but must come about gradually and without arbitrary interference from the organs of Government.

Dr. Fesca proves convincingly, from several examples, that of the three deciding factors upon which agriculture depends,—"the general agricultural conditions, the soil, and climate,"—the first is more influential than the second, and has indisputably hindered very much the development of Japanese agriculture. "The cost of transporting rice, which is the highest priced product,—fifty kilogrammes being worth about five marks,—amounts to the market price of the rice itself by the time it has been carried only twenty geographical miles, on the best highways, while in Germany, according to Settegast, wheat and other grain, at only twice that market price, say ten marks per fifty kilo., can be transported on ordinary roads 66·67 miles, on turnpikes 100 miles, and by rail 400 miles, before the cost of carriage reaches the market price. And on the poorer roads of Japan, rice does not bear a transportation of five miles. We find accordingly, that at some distance from the coast, even good soil has not been brought under cultivation, where the margin of profit is too narrow for it, while near the coast, even sandy dunes, certainly very poor soil, are successfully cultivated."[1]

The onward progress of agriculture was greatly obstructed, not only by insufficient means of internal communication, but also by the country's isolation from the rest of the world, during the long reign of the Tokugawa-Shôguns. There was no market for the surplus, and consequently no strong stimulus towards any considerable increase in production. Production was thus kept within the narrow bounds of the normal domestic demand.

The endeavour of the farmer must everywhere be to make the best use of the soil at his disposal, and consequently to increase the products derivable from it. And it is, no doubt, one of the first duties of the State to assist agriculture as much as possible in this endeavour, even to stimulate it; for there is a certain *vis inertiæ* in the conservative character of agriculture and a population devoted to it, which is all too well disposed to keep everything in its old groove and to meet all innovations with distrust and opposition.

From this point of view, the Japanese Government deserves full recognition for its efforts to promote agriculture. Neither can one withhold approval if in all this it did not disturb the organization of the industry as the peasants have been used to carry it on for many centuries, but turned its attention instead to regions, which had not been heretofore subject to this time-honoured method of farming—the island of Yezo,[2] for instance, and the vast expanses of the neglected forest and mountain meadows, or Haras. Cattle-raising, first of all, and also agriculture, were recommended and tried, but both in a different way from that formerly pursued.

A glance at the measures employed to attain these ends enables us to recognise the work of incompetent advisers, and a childish changeableness in the selection of means—a jumping about from one attempt to another. There was no well-considered plan laid down in the beginning, and no steady, business-like carrying out of any plan whatever. Naturally, therefore, the long history of these attempts shows an irresponsible waste of money on the one side, and for the most part a miserable result on the other.

This is particularly true of the *Kaitakushi* (pronounced kaitákshi, that is "development"), the Colonial-office, for the development of the resources of the island of Yezo, an institution established in 1869, which came to an inglorious end a few years ago. At its head was placed Governor Kuroda, with the rank of a minister. Having heard of the rapid development in agriculture and mining in various parts of the United States, they took that country as a pattern, and invited thence their advisers and officials. General

[1] Dr. Fesca: "Die Aufgaben und die Thätigheit der Agronomischen Abtheilung der Kaiserl. Japan. geol. Landesaufnahme." Yokohama, 1884.

[2] According to Lyman, this island has 7,000 sq. ri of land suitable for farming, 6,000 sq. ri of pasturage, 5,000 sq. ri of forest, 9,000 sq. ri of mountains. The arable land, therefore, amounts to nearly 25 per cent. of the total area.

Capron was installed as organizer, or "commissioner." Under him were a number of his American countrymen, acting as geologists, engineers, farmers, gardeners, etc., and in addition to them, a host of young Japanese, who were to serve their apprenticeship here. Some of these American officials were certainly capable men, who are not to blame because the success of the undertaking did not by any means meet people's expectations, and whose performances are not to be identified with those of General Capron.

On his recommendation, the Kaitakushi established on the Yashiki-ground of several former Daimiôs, near Tôkio, three so-called model farms, of altogether about ninety ha. These were to serve as experiment-stations and preparatory schools for Yezo—the first, for the reception of breeding cattle imported from North America and England, and the growing of fodder; the second, for the cultivation of vegetables and grain; the third, for the introduction of foreign fruit-trees, berry-bushes, and other useful plants. Of the cattle, brought at great cost from the countries named, a considerable number were carried off by disease; the rest were partly lost through unsuitable fodder and insufficient attention. Other model farms were established on Yezo itself, at Hakodate and the new capital, Sapporo. There was opened, also, in 1876, an agricultural school here, called "The Agricultural College of Sapporo," modelled after an institution in Massachusetts. There had already been a fiasco in Tôkio with another college designed for the Ainos. The geological survey of Yezo, the building of a road from Hakodate to Sapporo, new saw-mills, and many other things consumed a great deal of money. If it cannot be said that every undertaking of the Kaitakushi was ill-conceived and neglected, and came to nothing, it is, however, true of many. The general opinion of foreigners in Japan was, that the results stood in shocking disproportion to the enormous outlay. Vast sums were placed by the central Government at the disposal of the Kaitakushi. Thus, for example, in 1877 an additional 1,905,666 yen = about £380,000. It was, indeed, long the goose from which many contrived to pluck a golden feather.

In aiming to imitate America, they forgot that, in its case, the Government left everything to free competition and development, that the pioneers from Europe and the Atlantic seaboard, who pressed westward and spread their culture over deserts, were quite a different race from the Japanese and Ainos. In this, as in many other cases, the Government displayed lack of experience, blindness towards better advisers, and a desire to do everything through the State and as quickly as possible. And consequently the great hopes which it placed upon this new branch of its activity and development of power were followed only by disappointments, as was natural. An army of officials, divided responsibility, and want of earnest personal interest, crippling all strength and energy, will produce no better result anywhere. The mistakes of Governments have never been more prominent than in colonization affairs, as the latest European political history shows. Courage, intelligence, self-confidence, and perseverance in hard work, even in the face of misfortune—these are the qualities through which free, independent men have founded colonies and made them prosper. And if Governments have helped to this end, it was only by temporary, prudent backing, but never by taking matters into their own hands and thus crippling the individual forces at work.

And just as the Kaitakushi was extravagant, planless, and inconsistent in its operations, so many another bureau acted in its sphere. Thus, in 1874, American cows were brought to Kiôto-fu and put up in buildings over a gravel soil, on the river-bank, in a place where there was no such thing as pasturage far and wide, and to which fodder had to be brought, with great labour, from a distance. The same administration had heard about the advantages of flax-culture, a thing unknown in Japan. The requisite flax-seed was immediately procured from a European and an attempt made with it. The flax grew finely on the piece of land chosen for it in Kiôto, as I can testify. But when it had formed capsules and was ready for the harvest, there was no one who gave it the necessary attention and performed the labours that were now necessary. The flax ripened on its stalks and went to ruin with its bast.

Many a reader of these lines will recall the notorious "model farm" in Shimosa; but I do not care to refer here to all the examples of such perverted attempts to elevate agriculture. The right way for the Government, instead of taking everything into its own hands, would have been to encourage the inclination of foreigners to try farming in Japan, to turn over to them for a term of years State lands free of taxes, or for a moderate rent, and permit them to make their experiments. Had these succeeded, they could have served as patterns for the people, and have excited them to imitation; had they failed, the country would not have had to pay the costs.

But all such considerations were thrown into the background by a fear that concessions to foreigners for the pursuit of agriculture might injure the Japanese and lead to entanglements.

In 1867, and therefore towards the end of the Shôgun government, and at its behoof, a German farmer, named R. Gärtner, had established a model farm on Yezo and, two years later, taken it up on his own account. "Augustenfelde," as he called the estate, soon developed, under Gärtner's circumspect, capable oversight, into a really model establishment, perfectly adapted to farming under local conditions. But this did not last long. Scarcely was the new Government organized and established, before it bought in this estate, paying a good round sum for it, and that was the end of its prosperity. Yezo remained, to use Gärtner's own words, "a large, rich house, whose owners, like swallows, live only on its outside, in a state of extraordinary wretchedness." Its inhabitants are busied and even supported, though scantily enough, by catching the numerous fish and marine animals, and by gathering marine algæ and exporting them under commission for enterprising merchants. Captain Gill[1] says of Chinese agriculture, that in his opinion it has been very much over-estimated. That is true, also, of the Japanese, so closely related to it. In one respect, however, they are peculiar, namely in the care which is taken with ground once under cultivation, to see that nothing is lost.

Japanese farming is very much more careful, and more to be compared with the scientific horticulture and market gardening in the neighbourhood of our large cities. Japan possesses all the requisites for properly carrying out such methods, namely, division of the land among many small owners, plentiful watering, through rainfall and canals, and, above all, immense supplies of cheap and willing labour, to which also women and children contribute.

With all these advantages of cheap labour, combined with great industry and skill, the Japanese peasant can always keep the soil of his small holding loose and free from weeds. He can employ manures wisely, so as to get the most out of them. Of course, this kind of farming does not bring wholesale results, like robbing the soil on a large scale.

Kaempfer and Thunberg and other later travellers in Japan have spread the impression,—a false one,—that terracing has been more extensively employed than anywhere in Europe, and is customary high on the mountain-sides. The neighbourhood of Nagasáki and the Ômura-bay could easily give rise to this mistake. The basalt and trachyte rocks of these regions, so much decomposed by the weather, and peeling off so easily, furnish such a fruitful soil that rich harvests reward the weary building and care of terraces. With the pumice-stone of volcanic districts, or in slate-hills, the case is quite different. Here the mountain-walls are scarcely ever terraced very high, because the harvests from such meagre soil would not justify their existence. And terraces become gradually fewer the farther north one goes. Nowhere do they exceed, or even reach, in extent, in systematic development, and in success as marks of labour and skill, those of our own vine-dressers on the Rhine and in some of its side-valleys, as, for example, along the Mosel, and in the valley of the Ahr above Walporzheim.

Terracing in Japan, as elsewhere, is primarily for the purpose of protecting the soil of steep mountain declivities from being carried away by heavy rain-storms, and secondly to facilitate cultivation and irrigation. Now, since plenty of water is absolutely necessary for raising rice, and can only be had on a level field, the ground is terraced for rice, even where its natural slant is so slight that there would be nothing to hinder ploughing, after our fashion, and also no danger of the loams being washed off by rain. But to make these places perfectly suited for the purpose, it is sufficient to build

[1] "Journal Royal Geographical Society," 1878, p. 60.

simple smoothed earth-walls, 25 to 40 centimeters in thickness and height; though to support the terraces great works must be constructed along the walls of the valleys. So then we find cyclopean walls, not seldom built of boulders from the neighbouring river, or broader, grassy escarpments, upon which, in the south, tea-bushes, the wax-tree, or the paper-mulberry have here and there been planted.

There is only an apparent, not a real, contradiction between this last-mentioned fact, that terraces are often used for raising rice, and my former assertion that, in many travellers' accounts the extent of terrace-farming in Japan is much exaggerated. And this latter is easily seen from the low percentage of all cultivated land.

There were formerly no enclosed estates in Japan, nor pasturing herds. It was the universal habit to respect the fields and what was growing there. Thus there was neither opportunity nor reason to fence them in at all by means of ditches, walls, hedges, etc.; and separate pieces of land lay side by side, and do so yet, although receiving different kinds of cultivation. And in the plains and valleys, in order to save as much land as possible for the ever-important rice, dwelling-houses were built shoulder to shoulder in villages, and in a line with the roads. On this account, villages and country towns often lie along the chief avenues of communication, with no side streets to speak of, or are strung out on the borders of small plains. No vehicles of any description are used in Japanese agriculture, so that narrow lanes accommodate the general trade from place to place, and still narrower dams between fields serve frequently as footpaths.

As we have seen, agriculture in Japan is confined to a little over one-tenth of the country's area. And yet, not only is a very large population fed, but in favourable years there is also a not inconsiderable exportation of rice. It would be natural to conclude from this that the farming-land of Japan is distinguished by great fertility; and up to within very recent times this assertion has been often made. But it is by no means true. On the other hand, experience and even chemical analysis have shown that without most careful attention and manuring, the soil of Japan could in most cases produce no very favourable returns. Without properly understanding or applying the principle of rotation, the Japanese secures these results by subsoil working and loosening of the ground, by keeping it clear, or by repeated treatment with manure while the plants are growing, which last is possible with such crops only as are sown in rows and terraces. To this must be added plentiful watering, through rainfall or irrigation, and lastly the effect of long, uninterrupted summer heat.

Crops in Japan are seldom injured by untimely frosts or severe cold, and probably never, to any real extent, by mice or locusts. Among their living foes come, first, wild swine, which are very numerous, and then apes. On the edges of the forest and valleysteeps, these often are in advance of the peasant in the autumnal harvesting of his bulbs and grains, so laboriously grown. It is then a general practice to keep fires burning all night along the borders of the fields, and to fire off guns to frighten these importunate guests away. But the greatest damage comes from inundations. After many days of uninterrupted heavy downpour like a cloud-burst, or of gentler rain, the water comes dashing down the mountain-sides, sweeps away the terraces, and carries off their loamy soil; or the rising streams in valley and plain overflow their banks, bearing dykes and dams before them, and covering the fields far and wide with mud and boulders. The fruits of long industry, the joys of a toilsome existence, often disappear in a night. Showers of volcanic ashes, too, and typhoons, leave here and there, at longer intervals, their devastating traces.

The soil of Japan is largely the product of old shales, granite and trachytic eruptions decomposed by weather. It displays in most cases small natural fertility, so that newly-broken ground yields only scant harvests. The basic group of crystalline volcanic rock is poorly represented in Japan, especially basalt. Where it or basaltic lavas do occur, one observes in their concentric rings, which peel off under the action of the weather, that species of ferruginous loam, which, as in the basalt mountains of Germany, seems not to be wanting in the chief requisites of a fruitful soil. I found such soil on the road from Nagasáki to the Ômura bay, as well as in Gumai-gori, on the Kôshiu-kaido. Those rich deposits of loess which fringe so many of our valley-bottoms and are also widely spread in Northern China, do not seem to exist there;[1] and marl-soil, too, which is so productive, is not so frequently found in their lowlands as one might expect.

Analyses of the soil, in any degree of completeness, were only lately instituted, especially by Kinch,[2] Korschelt,[3] and Kellner.[4] With reference to the plain of Kuwantô, these corroborate fully certain old accounts of showers of ashes, which fell upon it, at different times, during eruptions of Fuji-san, Asama-yama, and other volcanoes. And they also proved, as was formerly discovered through examination and microscopic investigation of the ground, that the topmost layer consists essentially of volcanic ashes and tufa. According to Korschelt, the soil about Tôkio is, to a depth of 6 meters, a cement-tufa, six parts of which, with an equal amount of sand and one part slacked lime, give a good mortar, sufficiently strong in all cases except where great hardness is required. This tufa-soil consists of 85 per cent. zeoliths and sesquioxides, 11 per cent. mineral sand, 1·5 per cent. clay, 1·5 per cent. quartz sand, and

[1] At least I cannot remember ever having met with any in all my travels.

[2] "Transact. Ass. Soc. of Japan," vol. viii., pp. 369–416. 1880.

[3] "Mittheilungen der deutschen Gesellschaft Ostasiens," vol. iii., pp. 180–201. 1881.

[4] Nobbe: "Landwirthschaftliche Versuchs-stationen," vol. xxx., pp. 1–86. 1884.

1 per cent. organic matter. Kinch very properly points to the remarkably large proportion (40 per cent.) of easily broken silicates (*i.e.* the above-mentioned zeoliths), and the almost total absence of free silicic acid. Its richness in magnetic iron, to which, besides organic matter, this tufa-soil owes its dark-brown colour, was approximately calculated by Kinch with a magnet, and loam from Komaba gave 2·5 per cent. in one test, and some from Shimosa even 7 per cent. of the total weight. The soil of Japan has great capacity for absorption and for holding water; but being deep and porous, it suffers little from sagginess, even after heavy rains.

The predominance of acid silicates, including trachytic tufa and ashes,—of which the best loam in Japan is largely composed,—explains its extraordinary poverty in elements most necessary for plant-food: lime, potash, and phosphoric acid; and this poverty increases from the surface downward, as manures tend to make the top-layers more fertile. Kinch determines as follows the average content, from six tests, after deduction of the hygroscopic water:

Phosphoric acid, 0·185 per cent.; potash, 0·363 per cent.; lime, 0·475 per cent.

The results of his investigations, and those of Korschelt, were confirmed and considerably extended a year ago by the analyses of Kellner. Two of these follow here, taken from the work already cited, in Nobbe's "Landwirthschaftliche Versuchs-stationen," vol. xxx. The specimens of earth, like those which Kinch examined, were taken from the Kuwantô.

The earth was dried at 100° C., and then, by means of cold muriatic acid of 1·15 specific weight, were extracted the following:

	Soil of the Hata.		Soil of rice-land.	
	Top-soil.	Under-soil.	Top-soil.	Under-soil.
$Si\,O_2$	0·31	0·29	0·82	0·79
$Al_2\,O_3$	15·93	19·73	15·50	14·15
$Fe_2\,O_3$	11·73	11·36	7·00	7·49
$Ca\,O$	0·60	0·66	0·75	0·70
$Mg\,O$	1·41	1·44	0·45	0·55
$K_2\,O$	0·29	0·18	0·10	0·17
$Na_2\,O$	0·17	0·13	0·14	0·01
$P_2\,O_5$	0·19	0·18	0·37	0·35
$S\,O_3$	0·11	0·12	0·18	—
Total	30·74	34·09	25·31	24·21
Insoluble remnant	48·30	49·48	50·00	51·16
Humus and Water of combination	23·67	18·33	26·02	25·83
Total	102·71	101·90	101·33	101·20

This comparison shows that the soils, corresponding to their proportion of aqueous double-silicates, are rich in chemically combined water and easily separated bases. Upon digestion with muriatic acid, 38·9 per cent. of top-soil and 40·8 per cent. of under-soil were converted into bases and acids in solution; of the rice-soil a little less, namely 33·6 per cent. of top-soil and 31·1 per cent. of under-soil. The amount of separated components equals about 50 per cent. of the total mineral substance of the soil, a proportion so high that it is generally observed only in lime and serpentine formations. The soils are rich in clay and iron compounds, but noticeably poor in lime and chemically combined carbonic-acid. The differences between Hata and Ta, with respect to the composition of their soils, is not very considerable.

By treating the soil with hot, concentrated muriatic acid, the following substances were dissolved or separated :—

	Earth dried at 100° C.				Earth free from hygroscopic and chemically combined water and humus.			
	Dry Fields.		Rice Land.		Dry Fields.		Rice Fields.	
	Top-soil.	Under-soil.	Top-soil.	Under-soil.	Top-soil.	Under-soil.	Top-soil.	Under-soil.
$Si O_2$[1]	15·60	18·15	18·60	15·58	20·44	22·23	25·15	21·01
$Al_2 O_3$	17·67	21·03	17·05	14·80	23·15	25·75	23·05	20·03
$Fe_2 O_3$	6·79	5·06	9·95	2·68	8·87	6·18	5·38	3·29
$Fe O$	4·03	5·87	4·71	5·31	5·29	7·20	6·33	7·60
$Ca O$	0·76	0·90	0·90	0·80	0·99	1·10	1·22	1·11
$Mg O$	1·70	1·74	0·66	0·62	2·23	2·18	0·89	0·84
$K_2 O$	0·27	0·26	0·32	0·26	0·35	0·32	0·43	0·35
$Na_2 O$	0·23	0·13	0·19	0·25	0·30	0·16	0·26	0·34
$P_2 O_5$	0·34	0·39	0·49	0·40	0·45	0·48	0·66	0·54
$S O_3$	0·20	0·11	0·16	0·08	0·26	0·14	0·21	0·10
Cl	0·07	0·09	0·03	0·03	0·09	0·11	0·05	0·04
Total.	47·66	53·73	47·06	40·81	62·42	65·85	63·63	55·25
Unseparated.	30·20	28·64	27·10	33·40	39·56	35·07	36·63	45·03
Humus and water of combination.	23·67	18·33	26·02	25·83	—	—	—	—
Total.	101·53	100·70	100·18	100·04	101·98	100·92	100·26	100·28

It is seen from this that the separating effect of boiling hot muriatic acid does not much exceed that of cold.

The plain of the Kuwantô, to which the preceding analyses refer, although now-a-days cultivated like a garden, was first brought under cultivation in its present extent through the Tokugawa and

[1] Soluble in $Na_2 CO_3$ and taken up by $H Cl$.

in consequence of the development of their residence, Yedo. Its soil has the reputation, among the Japanese themselves, of being less fertile than that of many other parts of the country, especially of the richly watered plain of Mino, the plain of Hiróshima, the province of Higo. But of these we have no analysis.

In the Japanese system of soil-improvement, stable manure and rotation of crops play only a subordinate *rôle*. The productive capacity of arable land is gained and maintained by sub-soil working, appropriate use of the manure which is on hand, proper watering, and extraordinary care in working their fields and keeping them clear.

The East Asiatic knows and has followed, from time immemorial, the important principle of rational farming, that the soil must receive back in manure what is withdrawn from it in crops, although his action is no more based on scientific knowledge than is that of an old-school German peasant. But, for all that, he must be acknowledged to have more circumspection and more intelligence in selecting and using manure. Much that the rational farmer in Europe had to learn through theory and experiment, was in part an old-established practice in the agriculture of countries of the Chinese civilization. And this circumstance, together with a favourable climate, is undoubtedly the reason why the soil in China and Japan has preserved its old productive power, notwithstanding that, in Japan at least, as we have seen, it is not at all fertile by nature.

Nowhere else in the world is manure (Japanese, Koyashi or Koye) more carefully and industriously collected and drawn from various sources, or more rationally utilized, than in East-Asia. The droppings of beasts of burden along the roads is usually taken up on the cheapest conceivable shovel, a flat ear-shell (Haliotis) on the end of a stick, and carried to the fields in baskets. At no time of year, however, does the Japanese put manure on fallow-fields, there to dry up and be robbed by the wind of its most valuable element. And various as the materials may be which are thus turned to account, care is always taken to get them quickly into the ground, where they can begin to operate. The Japanese does not so much manure the soil as the plants themselves, knowing that only in this way a satisfactory result can be obtained. He provides the places where seed is planted or sprouts are set, with manure. As they grow, he supplies the plants with new manure at regular intervals. And thus he follows the most direct and economical method conceivable, which we call "head-manuring" (Kopf-düngung).

Stable manure, the chief fertilizer in our economy, is of minor importance in Japan, because stock is so scarce; and only in mountainous districts, with their wide grassy stretches and greater need for beasts of burden, has it much significance. Here, one can sometimes see dung piled up in front of peasants' houses, as in many a German village. Cattle and horses,—the only domestic animals hitherto worth taking into account,—are fed in stalls the whole year round, with few exceptions, so that the traveller in Japan seldom if ever sees a pasturing herd.

Long before our farmers had had their attention drawn by chemical investigations to the high proportion of nitrogen, phosphoric acid, and potash in cesspool manure, and learned to value and use it, this played a distinguished *rôle* in the empirical agriculture of China and Japan. Human excrements compose here the manure which is most employed and therefore of most account. Fish-guano and oil-cakes are the only things preferred to it. The chief growth-giving element of this cesspool manure, especially for grasses,[1] and thus also for straw-plants, is, as is well known, nitrogen, which is mostly present in the shape of urea and carbonate of ammonia, but escapes if the manure is not soon applied, on account of the quickness with which these bodies are decomposed, forming free ammonia.

How they gather these human excrements and turn them to account is a highly interesting question, since the problem of purifying our cities, and meeting the increased demands upon our agriculture, has been already so much discussed. The chief points regarding it will therefore be given here.

The system is simple, but will hardly be imitated by us, for it has not that regard for eyes and noses which our civilization demands. The corresponding senses of the Japanese are probably no less acute than ours; but the habit of seeing and smelling dung has evidently made them accustomed to it, in much the same way as practitioners in anatomical and chemical laboratories get used to sights and smells which nauseate the beginner.

There are regions in Europe where the way to the closet is through the kitchen; in Japan it is, as a rule, through the best room, or at any rate close by it. Japanese dwelling-houses are built lightly of wood, and only one or two storeys high, tending generally more to length and depth than to height. They never have cellars and chimneys, and generally no foundation-walls either. The lower floor rests on posts or stones two or three feet above the ground; kitchen and ordinary living rooms almost always face the street, with the better rooms on the other side, fronting a garden, from which they are separated by a verandah about a meter broad. A step along this verandah takes one to the closet adjoining it at one end, called Chôdzu-ba, Yôba, or (vulgarly) Setzu-in. On account of the light open framework of the house, it often happens that the odour from this place floats directly into its best rooms, as any one who travels in Japan can often enough observe.

The Chôdzu-ba has a floor of deal, with a rectangular opening in the middle, and a tub or a large earthen jar as a receptacle

[1] See Lawes and Gilbert: "The Effect of Different Manures on the Mixed Herbage of Grass-land." *Journ. Roy. Agric. Soc.*, vol. xxiv. Part I.

beneath. There is no seat; but the removable frame, which lies around the opening, has at its front end a small post to hold by. This provision distinguishes the Chôdzu-ba favourably from similar conveniences among very different nations, the inhabitants of Morocco for instance, and the ancient Romans.

For urination there is almost always some particular provision, except only at night. The vessel for receiving urine stands in a corner, and is usually sunk in the earth. In the better class of houses it is covered with a four-sided based pyramid, the interior of which is half filled with short evergreen twigs. In this way or otherwise the urinal is generally concealed from passers-by. But there are still cities that are far enough yet from such a refinement of manners, and where the old Chinese plan is still in vogue, which appears from old accounts, Thunberg's, for example, to have been formerly almost universal.

Two particularly striking instances of this sort fell under my observation in 1874, while travelling. I suppose I may mention them here. In the town of Takaóka, in Echiú, noted for its bronze-foundries, I found two rows of such vessels, only quite without cover of any kind, set up in the principal street. And later, in the town of Sakata, north-east of Niigáta, I came across this publicity in a still more striking form. Here every house had an arrangement of that sort right at the entrance, and my hotel (the Yadoya) had two of them, just about where the *portier's* office is with us. This may have been formerly the rule in all towns, now it has already become quite an exception. Indeed, there is really less offence against public propriety now in Japan, than in many places in Germany.

In large towns the Koye-tori (literally bringer of manure) comes almost every day to get dung (Daiben) and urine (Shôben) and carry them out to the country. He mixes both, and thins the composition with water, when necessary, which is an easy matter, owing to the peculiarly light diet of the Japanese, consisting of strongly-salted soups and sauces and easily-digested rice.

But there are others still, besides the regular Koye-tori, who are glad to take away the contents of these tubs. In Germany it is a common sight to see the farmer who has brought milk, butter, and other commodities to town, go back laden with refuse from his customers' kitchens, with which to feed his cattle. In Japan there is no vendor of butter and milk, and consequently no need of fodder; and instead of kitchen stuff, the countryman who comes in to market often takes back, for his fields, cesspool manure, in buckets slung on a yoke of bamboo-cane or evergreen oak.

The Sumida-gawa is the principal depôt of this refuse in Tôkio, the capital. Flat boats laden with it are to be seen every day along its banks, either directly filled with the manure, or carrying it in tubs arranged in rows and one above another. These manure-boats float in the river and through the fields in side-canals.

When such a boat reaches its destination, its contents, already thinned with water, are baled out with dippers by Hiakushô (peasants). Small tubs on long poles serve for dipping out and transferring the manure, and still smaller ones for distributing it to the plants. Thus the plants are manured and watered at the same time. All young winter produce and vegetables are treated in this way, but never rice.

It is only in time of a great abundance that this manure is collected in little vats sunk in the fields, and in big buried casks and tubs, roofed over with straw, for later use. As a rule, it is applied direct and fresh, so that its strength, especially of ammonia, is kept from being dissipated.

In many Japanese cities the carrying away of cesspool matter is provided for by companies under whose employ are the above-mentioned Koye-tori. These companies pay the householders for this privilege prices which rise and fall with the time of year, according to the demand. They are highest in spring, falling off in winter frequently by more than one-half. Ten years ago the average price in Yokohama for a ka (a man's burden, here two bucketfuls) was from six to eight sen. Three years ago it rose to ten sen ; in April, to twelve and a half, and in this month the company sold the manure to farmers for fourteen and fifteen sen per ka. In Tôkio, where the demand is less in proportion to the enormous amount exported, the prices are relatively lower ; in many smaller places, higher. It is comparatively within recent times that cesspool manure has become of any value and an object of purchase with us, as in Stuttgart, where it is bought by the Suabian peasants.

A great *rôle* is also played by compost (Koye-tsuchi, manure-earth, or Koyashi-tsuchi). This is prepared from earth and every possible sort of vegetable and animal offal, and is often moistened with dung-water, or even with water merely, in order to hasten decomposition. Lime is never used for this purpose. On being applied, compost often receives an addition of dung or even of green manure.

Fish-guano is the most expensive and highly-prized of animal manures. It is an important article of commerce, made up of the offal of various kinds of fish, but especially of several varieties of herring, for example the Nishin (*Clupea harengus*), the Iwashi (*Clupea melanosticta* and *Cl. gracilis*), and the Isaza (*Engraulis japonicus*). These fish appear in great shoals, in March and April, and again in October and November, off certain parts of the Japanese coast, the eastern shore of Yezo, for instance, the coast of Hitachi, along the shores of the Japan Sea, etc. They are not smoked or salted, as in Europe, but chiefly caught for the sake of a kind of train-oil, while their ill-smelling remains, when dried, appear in commerce as manure. After the oil has been extracted by boiling the fish in water, the remains are spread out in the fields, dried in the sun, and then exported either loose or pressed. Thus, for example, a single place, named Tomacomi, on the coast of Yezo, furnishes yearly about 150 tubs of fish-oil and nearly 7,000 Koku of fish-manure. This vile-smelling but very effective fish-guano is used, among other things, for manuring tea-plants. The refuse of silk-worm culture is also made useful as a fertilizer.

Another very valuable sort of manure consists in oil-cakes, or Abura-kasu, which, with fish-manure also, is employed in hastening the growth of young cotton and tobacco plants. They are obtained from the seeds of the different oil-bearing plants, as *Brassica*, *Sinapis*, *Perilla*, *Sesamum* and *Gossypium*, and have, naturally, very unequal values as fertilizers. Abura-kasu, in general, signifies the commonest and most valued, namely, the rape-seed cakes.

Besides these oil-cakes, as further vegetable manures, boiled or pounded beans, rape-straw, barley-straw, wheat-straw, chaff, and other refuse, and especially green plants, are used. Green manure is not, like clover and other plants in China, obtained by special sowing, but is taken from uncultivated patches of ground. It is a mixture of grass, weeds, undershrubs, and young branches, as they grow on mountain-sides and in thin forests. Women and children gather this material and take it to the fields in baskets, though, where it grows higher and farther among the mountains, the work is done by men with pack-horses. Like rape-straw, it is chiefly used for manuring and strewing rice-fields, when the latter are made ready to receive the young seedlings in early summer; and it is totally decomposed in a few weeks by the action of water and mud.

On Amakusa and other southern islands, I observed coarse sea-weeds spread as manure, especially *Sargassum*.

Of mineral substances, wood and straw ashes, especially those of rice-straw (Wara) and rape-straw are used; also the mud of the irrigating canals, with which the seed-beds for young rice are covered in spring. Ashes and mud are, in general, favourite fertilizers for hastening the growth of young crops.

The extensive use of lime has a greater interest for us. As is well known, the French distinguish between *amendement* (soil-improvement) and *engrais* (manuring). Quick-lime serves both purposes. Chemistry teaches that, in close contact with clay, silicates, and water, it frees the silicic acid combinations and makes the silicic acids accessible to the plants, and that therefore a heavy clay soil becomes looser and more fruitful through the addition of slacked lime, quite apart from the direct worth of the lime as plant-food in soil hitherto devoid of lime.

In Germany we see lime thus used, for example in the valley of the Sieg, in Saxony, and various other regions. But it is unlikely that any European farmer, by his own observation and experience, arrived so early at such practical results as the Japanese, or has so long been used for manuring heavy clay soil.

I observed powdered quick-lime, called Ishi-bai (stone-ashes), employed in various parts of Japan, principally, however, in non-volcanic districts, where the soil is poorer, being the product of older weather-worn shales and crystalline rocks. Its use, moreover, was confined, as a rule, to rice-fields. When these, at the beginning of summer, are prepared for the reception of young seedlings, and green manure, or rape-straw, is spread out over their muddy surface, lime is strewn over all. It quickly decomposes the fibres of the plants, thereby furthering the distribution and effect of such manure. On account of its caustic properties, it cannot be applied as a fertilizer to growing plants.

Limestone appears only exceptionally as a pure carbonic salt. So it is plain that its effect as a soil-improver may often be heightened through the admixture of phosphate of lime, magnesia, iron and other bodies.

Other summer plants besides rice are manured generally with straw-ashes or wood-ashes at seeding-time, and with dung, thinned with water, during their growth. This fluid manure, with the frequent rains, renders artificial watering of the Hata unnecessary. The porosity of the soil and its sloping position make drainage likewise dispensable, except such drainage indeed as is provided through the division of fields into narrow beds with deep furrows between. This is especially the method of planting winter products ; as is done also in the South of France, near Bordeaux, for instance. Improvement of the soil by mixture is not known, and neither is the so-called fire-culture (Brandcultur).

But there is another fertilizing element in the rice-lands besides lime, green manure, and straw manure, and that is the flowing water with which they can be flooded. In this are contained not merely valuable mineral products of erosion, but also decomposed vegetable matter. The soil's power of absorbing these substances has been proved beyond all doubt. Kellner's chemical examination of water as it passed off, after trickling through the ground, showed fewer mineral constituents than were found in river water.

Japanese agricultural implements are mostly simple and serviceable. But the latter quality cannot be claimed for those used in raising and harvesting grain, resembling closely, as they do, those used in China and Corea, and having evidently been little changed in the course of many centuries. Manual skill, industry, and perseverance take the place, in Eastern Asia, of our better adapted tools.

The plough (Karasuki) resembles, in its commonest form, that of Egypt, which we know is made and used to-day just as in the time of the Pharaohs. At the front end of its beam, which is about two meters long, there is the simple arrangement of a yoke for attaching the horse or ox, while at its other end a crooked piece of wood is fastened, pointing out backwards, and forming at its lower extremity the breast, ending here in the iron-pointed ploughshare. A cross-bar through the thinner end of the ploughtail forms the handle. The Japanese plough is therefore without fore-plough, coulter, or loam-board, that is, without any arrangement for turning furrows or for ploughing deep or shallow at will. The peasant carries it afield on his shoulder, walking after his ox or horse. With such a plough there is no possibility of thoroughly working the soil by clean, regular, successive furrows, or of cutting roots and laying them bare. It is no wonder that it is not extensively used, and that all deeper working and loosening of the soil is accomplished with the hoe (Kuwa) mostly, and the spade (Suki). The former especially is known in all forms and sizes, and is indisputably the most important tool of the Japanese gardener and farmer. It consists of an iron disk, which as a rule surrounds a wooden centre or hub, through which runs the handle, sixty centimeters long. A second form is the iron four-tined fork-hoe, and then comes the Kumade with four bamboo tines, and the Matsubagaki, with seven tines of the same material. These prongs radiate from one point, and form a right-angled triangle, at whose base they end, and are bent downwards, hook-fashion. These two implements form, to a certain extent, the transition to the simple rake (Sarai). I have seen ploughs used, chiefly in spring, for working rice-fields, but even in this case only sparingly. Remembering that rice-land, after being provided with dykes and then flooded, is worked with the hoe and by hand to an even and uniform paste, one recognises that subsoil culture is employed here, ploughs or no ploughs.

For a harrow (Maguwa, pronounced Magwa), they often use an implement which resembles more a large rake, its principal feature being a board with a row of wooden or iron nails. It is attached to the draught animal by two wooden shafts, and has a gallows-shaped arrangement on top which serves as a handle. But there are many modifications of this implement.

Wagons (Kuruma) are not used at all in Japanese agriculture. They have not even the wheel-barrow (Ichirin-sha) so popular in China. Manure and seed are taken to the fields, and their products in turn are carried home or to market, in vessels slung on both ends of poles laid across the shoulder, or on the backs of pack-horses or oxen.

Especially simple, or rather primitive, is the grain-harvesting. Straw is used chiefly in plaits of many sorts, ropes, sandals (even for beasts of burden), and mats, but also for thatching, and somewhat for manuring too. Grain is usually cut close to the ground with a sickle (Kama), as in Germany, and then bound in small sheaves. These are either stacked about the stems of alder or other trees along the edges of the fields, or piled in front of the houses, and when necessary, exposed to the sun for drying and maturing.

Taking such a bundle by the stalks, and spreading it out in their hands, they draw it through the steel or bamboo nails of a kind of comb like a flax-rippler (Ine-kogi or Mugi-kogi) of from thirty to forty centimeters in diameter, thus separating the ears and panicles from the straw. Instead of a rippler of this sort, poorer people use a piece of bamboo-cane cut in the shape of a fork or a comb (Kushi) of the same material. The panicles of rice and millet, or rather the grains themselves, are also often separated from the straw by beating the stalks against the edge of a tub. It will be asked: Have the Japanese no flails? We do find them in use, under the name of Kara-sao and Kururi, but in an exceedingly clumsy, inadequate shape. They consist of cylindrical pieces of wood, tied by ropes to poles, so that it is impossible to strike out well, or to beat hard with them. And the ears of grain are only threshed after being broken from their stalks by the above-mentioned processes. The threshers stand in two rows opposite each other, and each row strikes in unison, so that there is no such pleasant triple and quadruple beating of flails as salutes the ear from the threshing-floors in the German peasant villages in autumn.

Another method of separating the grains from the ears or panicles is by means of a stamping trough (Usu). When they are, in one way or another, separated from the chaff, the cleaning is not done on the threshing-floor with pitchforks, but, as in almost all warm countries, with the help of the wind, the mixture being held out at arm's length, in a sieve, where there is a draught, and then let fall to the ground. The light chaff, of course, flies away from the grain, the reverse of what happens on the threshing-floor by using the fan.

With leguminous plants, the pods are generally opened and deprived of their contents by hand, and less often with mortar and pestle. But for rape-seed, the pods are opened by beating the stalks against the edge of a tub or a basket.

Seed is said to be sown broadcast, or in rows. In sowing broadcast, the sower strides up and down his field in lines and with measured paces, and scatters the seed in regular movement, with a wide sweeping motion of his right arm, trying to cover it afterwards with harrow or rake, as the piece of ground is large or small. But this never succeeds perfectly, for the seeds are not all buried to the same depth, and some always remain on the surface, and go to waste. And then, too, the distribution is often very unequal, being dependent on the sower's skill, the lay of the land, the weather (for example, the presence or absence of wind), and other matters. In row-planting, the seeds are put into the ground at a more equal depth and distance, and into open holes, from two to ten centimeters deep, and then covered to an even height with loose earth.

Drilling[1] is essentially the same thing, except that it is done with machines constructed especially for the purpose, whereas ordinary

[1] See C. J. Eisbein: "Die Drill-cultur." Bonn, 1880.

row-planting is done with the hand merely, or perhaps with a stick to drill holes. The former is, accordingly, employed in farming on a large scale, while the latter is more in use among small farmers and gardeners. Although row-planting, of which planting in hills is only a special form (*e.g.* beans), has long been customary, broadcast sowing has been and is yet always the rule in Germany, where only of late and on large estates it has been laid aside. In the South of France, around Bordeaux for instance, sowing in rows has long been thoroughly carried out, and the fields for winter crops have in consequence been divided into long narrow strips, as in Japan.

The Chinese and Japanese farmer, who works only with simple tools, avails himself almost exclusively of row and terrace-planting, except in the case of the little seed-beds in which he cultivates the seedlings of rice and other growths. It is intimately bound up with the entire agricultural system of Eastern Asia, and possesses a number of advantages—economy of seed, and simultaneous and equal sprouting, rooting, and development, in consequence of the seeds having been placed at an even depth and an equal distance apart ; but above all, greater possibility of loosening the soil often and keeping it clear, and a better opportunity of watering and manuring the plants while growing. Finally, too, it permits of sowing for a second crop weeks before the first is ripe for harvesting. Thus, in the province of Higo, wheat is sown in rows in autumn, beside the maturing rice; and near Sakai, in the plain of Ôzaka, cotton is sown in spring beside winter barley. I have often observed tobacco and rape to be nurtured in the seedbed, and then transplanted to the fields when the latter had become free.

With their loose soil, unencumbered with stones and weeds, the Japanese are not acquainted with the obstacles which oppose drilling in other countries, and make it necessary to sow by hand. And it is a fact, that, when skilfully done and on fertile soil, broadcast scattering, as experience teaches, brings richer harvests, because the stalks grow closer together.

The greater part of the Japanese rice-lands lie fallow all the winter, for either the soil is not strong enough, or the winter is too long for the succession of a winter crop and a second harvest. Soaked with water, and in part covered over, it becomes, with its neighbouring ditches and their dead rushes, the gathering-place of many water-fowl, in the inclement season. Only in milder districts and on particularly fertile land, are the fields turned into a dry *hata* after the rice-harvest ; and then comes the planting of barley, wheat, peas, broad-beans, rape, mustard, or radishes, with which the other kind of ground is also covered, that which serves for all kinds of dry-crops in summer.

When rice harvest is over, about the end of October, the ground, already dried, is subjected to a thorough turning-over with the hoe, and the field is divided into long, narrow, high beds, in which the seed is planted in from two to four rows, from twelve to eighteen centimeters apart. In many cases, however, this takes place early in October, before the rice harvest, or the rape,—which has been started in seed-beds, like cabbage-plants with us,—is set out in furrows beside the rice, so that it is only necessary to dig over and heap up the earth when the latter has been removed. In either case the winter crop is richly manured again in March, and the earth is loosened and piled up around its stalks, as we do with potatoes and other vegetables. This custom originated, perhaps, in consequence of the fierce storms of dust in February and March, which, occurring after long dry spells, blow away the light, finely powdered loam, and lay bare many a root.

As in Andalusia and other districts of the Mediterranean basin, so in Japan, rape-seed, peas, and broad-beans blossom in April; barley and wheat put forth their stalks and ears; and then, towards the end of May, or in June, follows the harvest of all these plants.

Where there is rice-culture in addition, the field must, of course, be first turned into a swamp, and thus suffer a total change. But if the land is to bear other summer growths, their seeds,—as of beans, maize, and millet of various kinds,—are sown three or four weeks previously, in rows beside the ripening stalks of rape, barley, and wheat; or the little tobacco and cotton plants, egg plants, and other products which have been raised in the seed-bed are transplanted, generally weeks before the winter crop is ready for harvesting. It does not always happen that a great part of the plain is given over exclusively to rice culture in summer. Here and there, singly and scattered, dry fields appear, lying from one-third to one-half a meter higher, and planted with millet, cotton, beans, various roots, and other growths. They stand out above the bright green rice-plain as the isolated flower-beds in our gardens rise above the well-kept turf.

In the classification and consideration of Japanese field products to which we now proceed, I have, in general, followed the natural division of plant-culture in the majority of our agricultural text-books. The first and chief object of agriculture is to furnish food for man. This is obtained principally through cereals, pulse, and root crops. These groups therefore naturally precede all other products of the field, and their cultivation has the oldest history. After these come vegetables and other similar growths, which in some cases, as melons and the garlic family, have also been cultivated for thousands of years. Next come,—with respect to their use, at least,—eagle-fern, mushrooms, sea-weeds and preparations of sea-weed, and also the edible fruits furnished by the fruit-tree and the forest. Then follow the articles of food and luxury, which, like Saké, Shôyu, Tôfu, and others, are manufactured from grain and pulse. And the division which then follows of plants of commerce, embraces stimulants and drugs, and also oil, textile, and dye-plants.

Some important representatives of this last group, as oil-seeds, flax, hemp, and tobacco, flourish in Japan, and even in Yezo, most excellently. It will therefore be necessary, in the extension and rational pursuit of agriculture, to pay particular attention to their cultivation. In grain-culture the introduction of better seed in place of the ordinary sort is demanded for wheat and barley, since these have decidedly degenerated in the course of time, bearing lighter kernels and producing smaller crops than with us. They are of less importance in Japanese household economy than rice, and hence the same attention has not been paid to them.

Rice, leguminous plants, fish, and eggs have always played the chief part in the food of Japan, in which combination the rice, so rich in starch, is sufficiently complemented by the amount of protein in the others. But in mountainous regions it has been largely replaced by the various sorts of millet. In this relationship modern times have brought about no appreciable change.

The Japanese, like his neighbour to the westward, first became acquainted with bread and similar baked foods through the Portuguese. From them too he adopted the names *Pan* and *Kasutera* (pronounced Kastéra, that is, Castilla), by which is designated a spongy, saffron-yellow cake. He remained, however, true to his old way of living, and did not imitate the bread at all, and the cake only in rare cases, so that even now a foreigner travelling in the interior of the country must provide himself with bread or some substitute for it, unless he can and will accommodate himself to the Japanese fashion, and be satisfied with rice and grits.

Of the various more or less extensive catalogues of cultivated and useful Japanese plants, the following are known to me and were made use of in preparing the divisions of my subject which come next:—

1. Kaempfer: "Amœn. exot.," pp. 766–912. Lemgo, 1712.

2. Thunberg: "Flora Japonica." Leipzig, 1784.

3. Thunberg: "Resa 4. delen. Åkerbruket," pp. 76–92. Upsala, 1793.

4. Von. Siebold: "Synopsis Plantarum Œconomicarum Universi Regni Japonici," in "Verhandelingen van het Bataviasch Genootschap," XII. deel. Bat., 1830.

5. Scherzer: "Fachmännische Berichte über die österr.-ungar. Expedition nach Siam, China und Japan." Stuttgart, 1872. pp. 175–220.

6. Kinch: "List of Plants used for Food, etc., in Japan. Transact. Asiat. Soc. Japan." Vol. xi., pp. 1–31. Yokohama, 1883.

7. Dupont: "Essences Forestières du Japan." Paris, 1880.

8. Reports on various Universal Exhibitions.

In order to make the subject clear, and to accompany the several names of plants with such remarks as suit the measure of their importance, I have decided to adopt a plan of my own in grouping and handling the subject, relying chiefly on my own studies and observations, and this, not so much on account of the greater or less completeness and correctness of these lists, as because, with the exception of those mentioned under 5, 7, and 8, they fail entirely to indicate the relative importance of the plants which they record.

2. Food-Plants.

(a) *Grain, Stalk-plants or Cereals, Japanese Koku-motsu.*

(Some of these names of millet have been translated literally; the translator not being able to find English equivalents.)

Of this group, the following are cultivated in Japan as winter crops: barley (O-mugi), naked barley (Hadaka-mugi), and wheat (Ko-mugi); and as summer crops, rice (Kome or Ine), common millet (Kibi), Italian-millet (Awa), crowfoot-millet (Hiye), finger-millet (Kamomata-kibi), Guinea-corn (Morokoshi), maize (Tô-morokoshi), and Job's tears (Dzudzu-dama). It follows from this list that two of our cereals, rye and oats, are wanting. If they are nevertheless found here and there referred to among the cultivated plants of the country, such reference is to recent attempts at their introduction, or other kinds of grain have been mistaken for them. I have never seen them growing there, and the witness of Ito Keiske, and others acquainted with the flora of Japan, shows that they are not known in that country. And the fact that v. Siebold's list[1] of Japanese *frumenta* does not include rye and oats, agrees with this. On the other hand, buckwheat (Soba), although belonging to an entirely different family, must be mentioned next in order, for the nutritive quality of its seeds and their use.

As already mentioned, the land which supports these various varieties of grain is of two kinds, namely *ta*, rice-land, and *hata*, dry-land; the difference being merely that the former is flooded and turned into a sort of marsh. It is the larger in extent, corresponding to the preponderance of rice in amount and importance over the total products of all other grain. Having regard to the immense predominance of rice, I shall begin now with a description of it and its cultivation, and then add shorter notices of the other stalk-plants.

1. Rice (Japanese Ine, Urushine, or Kome—*Oryza sativa*, L.). Upon a hollow stalk, not very strong, and from 50 to 120 cm. high, the rice-plant (Ine, or Urushine) develops a narrow, overhanging panicle, with single-blossoming ears, and from thirty to sixty—even occasionally one hundred—grains of seed. There are over two hundred sub-species of this ancient plant, with or without awns, varieties with white, yellow, brown, and black chaff and

[1] "Verhandl. van het Batav. Genotschap," XII. deel. Batav. 1830. "Synopsis Plant. Oec. Univ. Regni Jap."

beards, some that ripen early and some late. There is also a variety, mountain-rice (*O. montana*, Lour.), Japanese Okabo, which does not require so great an amount of water as the others, being satisfied, like other cereals, with the ordinary moistening of its roots by rain. Hence it grows in higher places and on sloping ground, and has also a shorter term of vegetation (four months, instead of five or six), flourishing therefore in climates which are too severe for common rice. But the stalks of this mountain-rice are shorter, its grains smaller, its crops less than those of the other kind. We therefore find it grown only to a very subordinate extent in the chief rice-countries of the world.

The grains of rice grow in close union with the awns, and are therefore angular, so that in this, as in their general shape and size, and in colour, they bear most resemblance to barley, without however being so well filled out in the middle. Unhulled rice goes, in India and in the trade, by the name of *Paddy*. It is often brought to Europe now-a-days in this condition, is hulled here, and in this way comes into the inland trade in fuller, handsomer form than that which was imported ready for the kitchen. To this advantage it adds also greater durability.

In other than tropical countries rice is one of the summer crops, and in its term of development,—usually six months (from May to October),—it requires an average temperature of at least 20° C., and a soil saturated with water, at least in the early half of its period of vegetation. Its need of a warm climate is greater than that of most other kinds of grain; and it demands a larger amount of moisture than almost all other cultivated plants of any importance, not excepting the date-palm. In consequence of these requirements we find rice culture only in the tropical and warmer parts of the temperate zone, especially in depressions where it is possible to water the level plain, or where this is rendered unnecessary by frequent copious rains. In all Eastern and South-eastern Asia, as Grisebach rightly remarks in his "Vegetation der Erde," the first natural principle of rice-culture in its earliest stage is the utilization of the rainy season, which follows the change of monsoon in spring.

But the advent of these monsoon rains does not take place always and everywhere with its usual regularity and strength. Wherever, as in most parts of Hindostan and Further India, irrigation is not extensively carried out, a delay of these monsoon rains causes a general protraction of planting; and a short supply of rain brings failure of the crops, and famine. Japan is to a certain extent independent of these monsoon rains, thanks to its mountains, rich in snow and water, and to its systems of irrigation, which, like those of China, are in part several thousand years old. It has therefore a fixed time for sowing and harvest, which we must consider quite necessary, owing to its long, cold winter. The climate in India, on the contrary, being warmer, the time for rice and other crops can be made to correspond with the rainy season; on the coast of Coromandel, for instance, it occurs on this account in winter.

The northern limit of rice-culture reaches lat. 45° at certain points in the Old World—for example, in the valley of the Po; in America, it remains ten degrees further south. In the southern hemisphere it goes only a little over the tropical line—in Madagascar, for instance. For Japan, the Tsugaru-strait, in lat. $41\frac{1}{2}°$ N., forms the northern barrier.

Wherever its main conditions are perfectly carried out, rice rewards the farmer's labour better than any other cereal, and bears from 30 to 40 bushels (at from 20 to 25 kg.[1]) per acre, or 40·5 per are. In Japan one Tan (300 Tsubo, or 10 are) of the best rice-land brings a return of 2·4 koku (4·36 hl.) of hulled rice, corresponding to 5·8 hl. of paddy, or 58 hl. to the ha, while the average yield per ha. is equal to 27·5 hl. of hulled rice, or 36·6 hl. of paddy. In Northern Italy, where rotation is the rule, and uninterruped rice-culture a rare exception, fresh land bears in the former case, when circumstances are favourable, 70 hl. per ha., and in the latter, 40 hl. The greater bearing-capacity is here to be ascribed to rotation and broad-cast sowing, and in part also to the greater fertility of soil.

Rice was cultivated in the monsoon region of Asia far back in antiquity; and although all certain traces of its origin are lost, the Buddhist peasantry of China and Japan regard it as a direct gift of the gods. But this much is certain—that, like so many other useful plants, it was disseminated abroad from India. The history of ancient China points to this in unmistakable manner, and not less so the circumstance that from the Sanskrit name *vrîhi* come the Iranic *brizi* and the Græco-Latin *oryza*, from which last word, again, all Romanic, Germanic, and Slavic names for it are easily derived.[2] The Russian calls it either *riss* or *saratschinskoë pschenó*—that is, "Saracen millet."

At present rice is grown throughout nearly the whole monsoon-region,—all over Japan, except in Yezo and the Kuriles; in Corea, China, all the Malay islands, in Hindostan, Farther India, in the Tarim-basin (for example, at Yarkand, and at Kabul nearly 2,000 meters above sea-level), in Persia, Armenia, and Mesopotamia, and (so far as is possible with their neglected systems of irrigation) in Arabia. Madagascar, probably in consequence of Malay immigration, was early acquainted with this plant, which furnishes there, to this day, enough for the chief article of food and to spare for the Mascarenes besides. Until after contact with Europeans, bread was as unknown here as in Eastern Asia. Arabs first brought rice-culture to the eastern coast of Africa and into the region of the

[1] Kg. = kilogram; gr. = gramme.

[2] See de Candolle: "L'origine des Plantes Cultivées," p. 310; and Hehn: "Culturpflanzen und Hausthiere."

Mediterranean—to the Nile Delta, Sicily, and Spain. Even now the rice-trade of Eastern Africa and the Mascarenes lies entirely in their hands. Through the same agency, rice culture penetrated through inner Africa to the tropical West Coast, where it is, however, carried on only in certain localities, as in Ashantee on the Volta, and in Liberia, whose coloured colonists introduced it from America.

In Egypt rice-culture is confined to the Delta region, being especially important at Rosetta and Damietta.

On the Balkan peninsula, land and climate occasionally are favourable to rice-culture, but the lazy Turks never. Where it used to flourish, as on the Maritza, the great negligence of the Government has caused it to disappear. The same is true in part also of Portugal and Spain. Rice is still grown in the latter country, in so far as the old aqueducts in the *huertas* of Valencia permit it.

Among European States, Italy alone plays an important part as a rice producer. In Lombardy, especially about Vercelli, in Piedmont, Venetia, and the Æmilia (but little in Sicily and Tuscany), there is raised yearly about 70,000,000 lire worth of rice, on an area of about 230,000 ha., so that rice-culture is an important factor of the national prosperity.

Let us now cast a glance at the New World, to complete this short survey. The first attempts to introduce rice in the Carolines date from 1647. In 1694 some more seed rice came to Charleston in a Dutch ship (from Madagascar), and was divided among the colonists by the governor, Smith. This was the basis of the rice-culture, which developed rapidly from that time. It is spread to-day over South Carolina and Georgia, and extends also some distance into neighbouring States. The total production, in the United States, of this most valuable of all sorts of rice is reckoned at 4,000,000 kg.

Rice-culture has never attained much importance in the Spanish-American republics, though it has in Brazil, where it is carried on in the coast provinces between the Amazon and San Francisco rivers.

The majority of the world's inhabitants eat rice; and for at least one-third of them it is the chief daily food. It is estimated that a Malay labourer of Farther India consumes monthly twenty-eight kg. of rice, and a Siamese as much as thirty-two kg., while the Chinaman and Japanese requires also not less than one kg. daily, if his food consists principally of rice. In Europe the Turks and the English are the greatest rice consumers; the former because the chief ingredient of their national dish, the Pilau, is rice boiled in water, and the latter using large quantities in making puddings.

The chief sources of supply are the Indian ports of Calcutta, Akyab, Malmein, Bassein, and Rangoon, also Bangkok and Batavia, Egypt, Northern Italy, South Carolina, and Brazil.

Rice contains less nourishment than most of the other kinds of grain, but is the most digestible of all. It is on this account peculiarly suited to children and old people, and is given to such and to sick persons in China and Japan, even in regions where it is regarded as a luxury which the healthy peasant and artisan may only exceptionally enjoy, as, for example, in the Chinese provinces of Honan, Shensi, and Shansi, and in the mountain districts of Japan.

The attention which the farmer of Eastern Asia, especially of Japan, bestows upon his rice-field is worthy of the highest recognition. At the season of tilling he adds to his bee-like industry that cheerfulness of disposition which enables him to perform this severe and dirty labour with ease and rapidity. The work begins in April with the laying out of one corner of the rice-field as a seed-bed. To this end the ground is first dug over with a long-handled hoe, then levelled and surrounded with a little smoothed and hardened wall of earth, from 25 to 40 cm. in height and thickness. A small gutter or irrigation-channel is brought into connection, when possible, so that the bed can be flooded when necessary. A favourite manure is the slime dug up from a neighbouring canal, if one is near. The seed-bed is covered with this to a depth of about 20 cm. In default of such slime, ashes must serve, and other quick-working fertilizers, such as stamped beans, compost, and fæcal matter. Next, the dam is broken at some point and water admitted, until the bed is covered to a depth of about 6 cm., when the seed, borne in a flat winnowing basket, is scattered over its surface with the hand. This seed is most carefully selected. In many cases it is kept under water several days beforehand. The grains of rice sink quickly and lie pretty close together on and in the mud at the bottom. In four or five days they sprout. Among other uses, the water serves to protect the fresh seed from birds. It soon evaporates or sinks into the ground and must be replaced, in case no rain falls, with a new supply from the ditch. As a rule, however, the seed-bed is flooded only at night and left dry by day. Thus it is protected against cold, while enjoying the warming influence of the sun.

In most parts of Japan the sowing of rice takes place towards the end of April or in the beginning of May, and the time for transplanting is from about thirty to forty-five days later. In certain districts,—for example, in the provinces of Mino and Shináno (south-west of Tôkio, in the interior of Hondo),—it is customary to begin cultivation from two to four weeks later,[1] in others, as at Kôchi, in Tosa (on the island of Shikóku), as much earlier. This depends partly on climatic causes, according as the temperature of earth and water requisite for the development of rice is attained late or early in spring. But a more important reason for this variation in time is, that in fertile depressions, like

[1] In Shináno the thirty-third day before Hange (July 2) is sowing-time.

the rich low-lands in Mino, the rice-land did not lie fallow, and its winter crops, especially barley and rape-seed, are not harvested till June, so that the field cannot be got ready for young rice-plants before the middle or end of this month.

By far the greater part of the rice-land of Japan lies fallow all winter and, covered in part with water, forms a kind of swamp, the rendezvous of wild ducks, geese, and snipe. This is especially the case where the ground is not adapted to producing two crops a year, either because the winter is too long and the season of vegetation limited to a few months, or because the soil is composed mostly of the less fertile products of disintegration,—old schists and crystalline rocks,—and therefore requires an occasional rest. But this is the only sort of rotation thought of in the rice-land of Eastern Asia. It has served the same purposes every summer for many centuries.

In other countries rice-fields are worked with the plough, drawn by buffaloes or oxen. In Japan and China this work is generally done by hand. The labourer goes about it barefoot and clothed only in coarse, hemp-linen drawers, reaching to the loins. His usual implement is a long-handled, three-pronged hoe, or a small spade. Thus one seldom observes draught animals used in rice farming—in the neighbourhood of Tôkio and Nagasáki, for instance. In certain other districts, however, as at Ôzaka and in the province of Mino, the land is ploughed.

The dams about old rice-fields and canals are covered here and there, in early May, with the beautiful blossoms of a kind of creeping papilionaceæ (*Astragalus lotoides*) as with a red carpet. At this time the preparation of the fields for the young plants is begun. To improve the ground, rape-straw, lime, and above all, green manure are strewn over it, as in China. But green manure is not produced here, as in China, by raising clover and other plants for this purpose. It is rather a mixture of grass, weeds, and underbrush, as they grow in abundance on the mountain-slopes and in the clearings of forests. As noted on p. 30, women and children gather this manure and carry it in bundles to the field, for which work the women are clad like the men, in home-made light-blue coarse hemp-linen drawers and blouse. When, however, this green manure has to be got higher and farther back in the mountains, it is carried on pack-horses. This vegetable manure is either thrown into the furrows in ploughing or hoeing the ground, or is scattered over its level surface, like powdered quicklime. Being covered with mud and water, it decomposes quickly, so that every trace of it disappears from the surface in a few weeks. I have seen quicklime and hydrate of lime used as manure for rice-land in the most widely different parts of the country, though never for other crops, and generally where the soil consisted of the products of crumbled schist and granite formation, not yet containing much decayed vegetable matter, and seldom in volcanic regions. Fæcal matter is less used in rice-farming than in other crops. One is thus not so much offended by the smell of it as might be imagined, on going through the flooded rice in summer.

When a rice-field has been dug, levelled, manured, and flooded with water,—which must be preceded by the construction of dams, —it is fully prepared to receive the young plants.

The system of irrigation is particularly important. Every partition-wall of the rice-field has one or more small apertures, here for the admission of water, there to let it out. When it comes from a mountain-slope, it is conducted first to that field of the valley-bottom or terrace which lies highest.

The little stream,—a stronger one would be too dangerous,—floods the field to a certain depth and then flows over into the next piece of ground, does the same thing here, and then goes on to the next level, and so forth, from terrace to terrace, till the entire system is watered. Natural river-beds, or canals with beds sunk lower than the fields, intersect the whole, so as to receive and drain away the water when it has served its purpose. Thus it always remains under perfect control, except only in case of long-continued, heavy rains.

In insufficiently watered districts, those that depend more on rain than on a supply brought in streams from higher, wooded hill-country, there have been ponds made, to help out, with their stored-up contents, the dry summers when natural resources fail. Many of these ponds are of a great age. Works of this sort are mentioned in the oldest history of the country as laid out by this or that Mikado. In flat neighbourhoods and after long droughts water-wheels are employed, as in China, India, and elsewhere, to raise the indispensable water from the deeper ditches and conduct it to the rice-fields. This is often done, too, with bare hands and with shovels. A favourite plan, which I saw used also in Japan, is as follows: two men, on opposite banks of a stream, suspend a closely-plaited winnowing-basket on a rope between them, and swing it backwards and forwards in such a way that it dips into the water at every downward movement of the arms, and empties, at the upward swing, into a conduit leading to the field. In autumn, when the ripening crop needs no more water, or at any time when there is rain enough to supply every need, the places of influx are stopped up and the spring-water is left in its natural channels.

Japanese rice-culture contrasts favourably, through this artificial watering, with that in the southern monsoon-region—in Siam, for instance; but it by no means comes up to that of the North-Italian plain, either in rational management or results.

There is probably nowhere in the world a system of watering carried out on a large scale so methodically and effectively as that by which the "Società d'Irrigazione dell'Ovest della Sesia" conducts the water of the Sesia to the rice-fields of Vercelli and its neighbourhcod. Every liter of it must be paid for; but its rational use richly rewards this expense, and many others, with high profits.

In June,—seldom earlier or later, and about 30 to 45 days after sowing-time,—in Japan the young rice-plants are transplanted from the seed-bed to the ground prepared for them, which has been flooded to a depth of 6 to 10 cm. These shoots (naë) have then a height of 18 to 24 cm. After being pulled up, they are tied into small bunches, not too large round to be spanned with the hand. One man takes a number of such bunches under his arm, and wading through the field, throws them singly right and left over the water, wherever they are needed. Others, both men and women, pick them up, and the planting begins. They set out the little bunches in rows, 4 to 6 plants in a bunch, calculating the intervals of 20 to 25 cm. skilfully with the eye, so that between 1,200 and 3,000 bunches go to an are. Silver-herons and cranes follow the busy planters, as starlings and wagtails fly after the plough with us, picking up slugs and snails.

Let one instance here show with what astounding rapidity all the above-mentioned proceedings take place:

In the spring of 1875 I had occasion to traverse, at different times, the plain of Ôzaka, which is watered by the Yodógawa, the outlet of the Biwa Lake. On April 1, the first rape-blossoms were visible. Barley and wheat had not yet put forth their stalks. There were but few fallow rice-fields to be seen. On June 3, scarcely nine weeks later, as I again travelled the same road, rape and barley harvest had commenced, and wheat was quickly nearing maturity. Once more, on June 26, three weeks later, I had an opportunity of seeing this fruitful plain and rejoicing in its fine cultivation. What a change had taken place in that short time! Of the winter crops —rape-seed, barley, wheat, peas, broad beans—of the high beds and deep furrows in the dry fields, of the countless happy mortals who were busy with the harvest on June 3—of all these there is now nothing to be seen. The whole wide plain appears as if transformed by magic. Great reaches of it have been levelled, girt about with dikes and ditches, and changed to a marsh. The muddy ground is covered everywhere with rice-plants of a lovely green, out of which, here and there, dry patches with other crops project singly. Now and again one sees a solitary farmer stalking through this field of rice, here regulating the ingress of water with his hoe, there pressing in a plant more firmly with his hands or replacing those that have not sprouted. Silver-herons fish in this artificial swamp between the green rows of rice-bunches, and men fish in the intersecting ditches. Yet a few weeks, and one looks out over a continuous carpet of the loveliest emerald-green, like a cultivated lawn, in which, also, there is no lack of flower-beds, in the form of small dry patches bearing cotton, millet, and vegetables.

When the rice has been transplanted, the earth-dykes are put to a further use. Small circular depressions are made upon them. In each of these are placed 3 to 6 dwarf beans, which are covered over with earth and rice-chaff. Then the chief labour is at an end. It only remains to go every fourteen days or so, when the rice-plants have commenced to grow again in their new soil, and set them in more firmly, and to crush and level any clods that still lie in the mud and water—operations which are performed solely with the arms and hands.

Now it is only necessary to attend to watering, and later on to weeding and a second hoeing along the rows.

Part of the farmer's time and energy can now be devoted to other employments, such as silk-culture, and gathering and preparing dyer's knot-grass (*Polygonum tinctorium*), which serves as a blue dye, like indigo. And there is leisure, besides, for taking a day's pleasure on some festival of the gods, or going on a pilgrimage to some celebrated mountain or temple, if a good harvest last year furnished the needful money.

The rice blossoms in early September. Harvest takes place from the end of September to the end of October, and even as late as November. It is the season when, in the temple-groves, the sere leaves of the Icho or Ginko (*Salisburia adianthifolia*, Smith) fall to the ground, broken off by the morning-dew, and the Momiji (*Acer polymorphum*, S. and Z.) become a splendid red.

"Behold the full panicles in the autumnal rice-field, every one a witness of the summer's heat and labour!" as is beautifully and appropriately said, in a recent collection of Buddhist sermons. And well may the sight of these "golden crops in the valleys" make glad both eye and heart. A whole bundle of straw, with heavy panicles, which has grown from every little group of shoots, richly rewards the industry spent upon them.

As in China, the ripe rice is cut off with short sickles close above the ground, for the straw too is a valuable and much-used material. The grain when reaped is hung up on poles in small armfuls, rather bundles than sheaves, or it is arranged about alder-stalks along the rows, or brought directly home. For threshing they do not use the flail, as with us, nor cattle (oxen and mules), as in the Mediterranean countries, but arrangements peculiar to themselves, which remind one of our flax-ripplers, used for separating the capsules from the stems. Another method, mentioned by Thunberg, is simply to strike the panicles against the edge of a barrel or a tub, whereby the grains fall from the stalks.

The grains of rice are, as a rule, not husked until needed. A simple and very widespread arrangement for this purpose consists of a round trough[1] hollowed out of a block of wood or a stone, into which the paddy is poured, to be pounded with a wooden

[1] The island of Luçon (Lozon), or Isla de los Losones, gets its name form these stamping-troughs (lusong).

pestle until hulls and kernels are separated. Water-power and similar arrangements are also in use as with us the stamping-apparatus in oil-mills.

The simplest, most primitive husking-machine is often found in Japanese mountain-valleys, and is used also for pulverizing materials in the pottery industry. A hewn beam plays the part of a two-armed lever. The heavier arm bears at its extremity a rectangular bolt shod with iron. This end is kept under cover in a frame building with the rice trough. The other end projects outside. It is generally the longer, and its extremity is hollowed out in the shape of a scoop. Upon this scoop there flows a stream of water, which fills it, and causes it to sink; whereupon the scoop empties itself, and the other end falls like a raised hammer, and so on. The work advances slowly, but here, in reality, "time is not money."

Rice is as closely bound up with the life of the Japanese as with the Malay and Hindu. This is shown, among other things, by the fact that his language has a different word for almost every particular form of it. Thus the young rice-slip in the seed-bed before being transplanted, is called Naye (pronounced naë); when more developed, in the field, Ine. Kome (or Kuromai) is the name for the grains (Paddy) after being cleaned from chaff. By Momi or Mominai they designate the unhulled, and Hakumai and Tsukigome the hulled rice. When the latter is boiled and warm, it is called Meshi, Gozen, or O-mamma (children's name for it), but Hiya-meshi when it is cold. According to the time of ripening, they distinguish Wase, Nakade, and Oku, that is, early, middle, and late rice. The first is harvested in the middle of September, the late rice, on the other hand, not till the end of October. The latter is by far the most important, and constitutes the principal crop.

As before mentioned, Okabo is the name for mountain rice, Uruchi for common rice, Mochi-gome (Chinese *no*, Malay *pulut*, Javanese *kattan*, French, *riz gluante*) for glutinous rice (*Oryza glutinosa*, Rumph.), a special sort, often with black hulls, of which it was formerly thought that a part of its starch had been resolved into dextrin.[1] When hulled, the grains of this glutinous variety can be recognised instantly from their light colour and lack of lustre, as well as from their resemblance to stearine when fractured. Its meal affords a tough, highly elastic dough, like the most glutinous kind of wheat-flour. It is particularly used for making little round cakes, which, filled with bean-meal and sugar, are eaten without being baked and are very much relished. It is also used for paste. This glutinous rice is cultivated throughout the monsoon region; and in its properties, though not in appearance, is the most noteworthy of all the many varieties of rice.

Since rice, boiled in water or steam, is the foremost dish in each

[1] For more exact information, see the analyses *infra*.

of the three meals among the Japanese, these are called simply Gozen, and are spoken of as Asa-gozen, Hiru-gozen, and Yu-gozen (literally, morning, noon, and evening rice), just as the Germans say *Morgen-*, *Mittag-*, and *Abendbrod*.[1]

The chief rice-harvest, that of the Oku, occurs towards the end of October, but the sowing in the latter half of April or the early part of May; so that this, the most important variety of Japanese rice, requires half a year to develop. Rice has an almost equally long term of vegetation in the Batta Lands of Sumatra and in various other tropical monsoon regions. Comparing in this respect the rice of the plain of the Po, about Vercelli, *e.g.*, with Japanese, it appears that the former begins to grow and stops growing a month earlier. Ostiglia and Japanese late rice are here sown about the end of March and harvested towards the end of September. After the first week in October, very little rice is to be seen in the fields of Northern Italy.

It has been already stated that the revenues of the Daimios and Samurai used to be reckoned in *koku* of rice[2] and were paid in kind, and also that the receipts from rice-land form the staple of modern taxation. Even the censuses were formerly made,—incompletely enough to be sure,—according to the production and consumption of rice. Nevertheless, there are hundreds of thousands of poor mountaineers who are glad if their small fields bear barley and millet. With them rice is a luxury, which at the most is given to the sick and to delicate children, but seldom to healthy adults.

Three principal rice districts are to be distinguished in Japan. The northern one of these sends its surplus chiefly to Tôkio. From the middle and southern, the greater part still goes to Ôzaka, which was always the great market for the rice and silk trade while the country was closed. The foremost rice-growing neighbourhoods of Honshiu or Hondo are as follows: the larger plains along the lower courses of the three leading rivers (San-dai-ka), the Toné-, Kiso-, and Shinanó-gawa, the plain of the Kuwantô, the plain of the provinces of Mino, Owári, and Ise, and also that of Echigo. Besides these are also to be noted the plain of Ôzaka on the lower Yodó-gawa, the Sendai plain, the plain of Akita on the Sea of Japan and of Mongami in the interior, the Aidzu-taira and Iwáki-taira, and several others. On Shikóku the following places are noted for extensive rice-culture: Awa, parts of Sanúki, and the neighbourhood of Kôchi; on Kiushiu, Higo, especially near the capital, Kumamóto, besides Bungo, Chikúgo, and Eastern Hiúga, on the Pacific.

Japanese rice is esteemed the best in all Eastern Asia, and is valued higher than that of Java or India. When hulled, it shows

[1] In China a meal-time is similarly termed *tschi fan*, "to eat rice." Williams: "The Middle Kingdom," vol. i. p. 772.

[2] A koku of rice (182·5 liters weighs on an average 145 kg. and costs in Japan 3 to 4½ dollars (12 to 18 shillings).

a medium-sized handsome grain, with a dull silky lustre and glassy fracture. It is very palatable. This especially holds good of the valuable sorts from the provinces of Higo and Mino. It was from the latter that the household of the Tôkugawa Shôgun in Yedo always drew its supply. A part of the rice of Japan is used in making Saké, or rice-beer. (See the chapter on this subject.) Rice-straw is not much used for foddering or bedding cattle, nor for thatching roofs, but it is chiefly employed in an industry of no little importance; sandals (for men and beasts of burden), rope, and other packing materials are prepared from it.

Of the various analyses of important Japanese food-stuffs which have recently been published, the following, with reference to rice, may conclude this subject:—

TABLE I.

	A. Common Rice.	B. Mountain Rice.	C. Glutinous Rice.	D. Glutinous Rice.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Raw protein . . .	7·00	8·75	5·87	8·89
Raw fat	2·29	2·58	3·44	0·68
Raw fibre	4·58	1·98	5·19	0·76
Starch				76·98
Dextrin	84·76	85·53	83·89	3·35
Sugar				8·65
Ashes	1·37	1·18	1·61	0·69
	100·00	100·02	100·00	100·00

In these analyses, A, B, and C, refer to unhulled, and D, to hulled rice. The first, with Table II., was published by Kellner in Nobbe's "Landwirthschaftliche Versuchsstationen," vol. xxx., 1884; the last, by Kreusler and Dafert, in the "Landwirthschaftliche Jahrbücher," vol. xiii., p. 767. Kellner found no difference worthy of remark in the chemical composition of swamp rice, mountain rice and glutinous rice. On the other hand, the other two chemists state most emphatically that the starch of the glutinous rice gave a brown iodine reaction, instead of the dark blue of ordinary rice-starch. This difference was, moreover, already mentioned by Atkinson, on p. 2 of his treatise on "The Chemistry of Saké-brewing," (Tôkio, 1881). But this by no means settles the question as to the cause of the unusual glutinosity of the meal of *Oryza glutinosa*, Rumph.

I received samples of the three chief kinds of rice from last year's harvest in Japan, all three of them being yellow-awned rice and scarcely distinguishable when unhulled. The weight of one hundred grains of paddy was 2,672 gr. for glutinous rice, 2,560 gr. for swamp rice (Oku), 2,209 gr. for mountain rice, and of hulled

2,188 gr., 2,189 gr., and 1,908 gr. respectively, so that 37·4 corns of unhulled glutinous rice, 39 corns of swamp rice, and 45·2 corns of mountain rice go to a grain. Of these weights, 81·9 %, 85·5 %, and 86·3 % respectively are due to the kernels and the rest to the husks.

TABLE II.

	1	2	3	4	5	6	7
	Swamp Rice.	Mountain Rice.	Maize.	Millet.	Sorghum.	Phaseolus radiatus.	Canavallia incurva.
Water	14·20	12·77	19·27	12·04	12·37	12·20	15·28
In the dry substance.							
Raw protein . .	9·84	11·27	15·22	8·43	12·34	20·84	25·55
Fat	2·66	2·57	5·08	4·40	6·17	1·62	1·76
Raw fibre . . .	1·45	1·62	2·50	1·54	5·32	6·89	13·54
Ashes (without C and CO_2) . . .	1·02	1·29	1·07	1·26	5·26	2·96	4·24
Starch	77·86	77·34	73·72	51·99	54·49	65·38	44·84
Raw sugar and dextrin . . / Glucose . . . / Other extractive-stuffs, free from Nitrogen . .	10·17	5·91	2·41	32·38	2·47 / 10·93	2·31	10·06
Total Nitrogen .	1·571	1·80	2·435	1·35	1·975	3·325	4·09
Albuminous Nitrogen	1·441	1·34	2·103	1·21	1·738	3·055	3·05
Non - Albuminous Nitrogen (though Cu OH)	0·130	0·46	0·332	0·11	0·237	0·270	1·04
Ditto (through Phospho-tungstic acid) . . .	0·047	—	—	—	—	—	0·81
Analysis of Ashes. In 100 parts of pure ashes:							
K_2O	22·94	21·73	32·64	20·57	21·44	45·14	35·99
Na_2O	4·94	1·59	1·74	3·34	4·89	2·61	1·85
CaO	3·24	2·12	2·21	2·36	2·61	3·49	8·29
MgO	10·54	6·61	10·45	14·12	14·48	9·98	7·66
Fe_2O_3	1·03	1·66	1·28	0·44	1·80	1·09	0·78
P_2O_5	51·37	51·99	44·13	39·59	49·72	33·05	36·93
SO_3	1·85	2·08	3·48	3·32	2·49	0·91	5·17
SiO_2	3·14	2·63	1·97	11·59	0·22	0·55	0·63
Cl	1·05	4·49	1·75	3·73	1·35	2·36	2·15
Total	100·10	101·90	99·65	99·07	99·00	99·18	99·45
Deduct O for Cl	0·24	1·01	0·39	0·84	0·30	0·53	0·49
	99·86	100·89	99·26	98·23	98·70	98·85	98·96

1 and 2 are hulled rice; 3 is maize, small yellow grains; 4, *Panicum italicum;* 5, *Sorghum saccharatum;* 6, *Ph. radiatus*, much cultivated, of the bean order; 7, *Canavallia incurva*, forms vines, little cultivated, husks about 20 cm. long, 6 to 8 reddish seeds, each weighing about 2·5 gr.

2. Wheat, Ko-mugi (*Triticum vulgare*, L.) Mugi is a collective name for wheat and barley, which are distinguished, from the size of their respective grains, as little (ko) and big (o) mugi. I have only met with this one kind of wheat in Japan (finding neither spelt, English wheat, nor any other).[1] And it has always been as a winter crop that I have found it,—generally bearded, though sometimes, too, without beard, both forms frequently being mixed in the same field. Sowing, as a rule, takes place in November, the development of blossoms and ears in May, and harvest in June. In northern parts, however, and in high-lying neighbourhoods, like Shináno, harvest does not begin till towards the end of July or the beginning of August.

It has been remarked in a former passage, and Maron noted it also, that wheat does not play a prominent part in Japan, and gives an impression of having degenerated, probably in consequence of insufficient seed-interchange. Its flour is mostly made into small cakes (Mochi), with a diameter of scarcely 5 or 6 cm. and eaten, like those made from glutinous rice (Mochi-gome), either by themselves, or in the form of dough, strewn with black bean-meal and brown sugar.

3. Barley, O-mugi (*Hordeum vulgare*, L.). The four-lined subspecies, *H. tetrastichum*, and the six-lined, *H. hexastichum*, L., a short-awned variety, are both cultivated, though as winter crops only. Sowing takes place mostly in October or November, bloom in early May, and harvest in July. Like buckwheat and the different kinds of millet, its grain is used chiefly in porridge, though as horse-feed and chicken-feed also. Two-lined barley, which Maron mentions also, I have never found, nor do I find it copied in any Japanese book. On the other hand, *naked barley*, Japanese Hadaka-mugi (*Hordeum vulgare*, *β*, *nudum* s. *cœleste*, L.), occurs frequently; it is easily distinguished from the common four-lined form by the mere outward appearance of its ears. Kinch mistakenly designates Hadaka-mugi as rye (*Secale cereale*, L.). It has also been confounded with spelt, *e.g.*, by Scherzer), an error that is hardly possible in the field, though perhaps easy enough when the grains alone are compared, they having more resemblance to hulled spelt than to rye. Japan possesses neither rye nor oats, as has been already stated. Kaempfer, certainly, brings in *Avena sativa*, L., under the name of Karasu-mugi (raven barley?). "Amœn. exot.," 834 ff., as also Thunberg after him. "Flora jap.," p. 54. But it is found neither in Siebold nor in Kinch, and I do not know any Japanese representation of it.

[1] Thunberg, Siebold, and Kinch also mention only *Triticum vulgare*, L.

From April to June inclusive, the various kinds of millet are sown in small furrows—less frequently in beds for subsequent transplanting. They are harvested in September and October. There come now for our consideration :—

4. The common, or panicle millet, Japanese Kibi (*Panicum miliaceum*, L.), which is grown much less extensively than the two following.

5. Club, or Italian millet, Japanese Awa (*Panicum italicum*, L. ; *verticillatum*, Th. ; *Setaria italica*, Kunth), a grain which, with the sort that follows, is oftenest grown on dry, light soil, especially in mountain regions. It is instantly recognisable by its thick cylindrical hanging panicles. There are a good many varieties, among which those predominate which, from their prominent, unfruitful, bristle-shaped, blossom-pedicles, appear as short-awned. The sweet yellow meal of its small seeds is of great importance as food, both in Japan and China.

6. Crow-foot millet, Hiye, Ko-kibi (little millet), in Thunberg (*Panicum crus-galli*, L. ; *P. corvi*, Thunb. ; *Oplismenus crus-galli*, Kunth). *Panicum frumentaceum*, Roxb. (*Oplismenus*, Kunth), is also grown under this name, Hiye, but not as often as the former sort.

7. Finger millet, Japanese Kamomata-kibi, or Shishi-hiye and Nora-hiye (*Eleusine coracana*, Gaertn.; *Cynosurus coracanus*, L.). In certain parts of India, as Mysore and the Punjab, this smallish unpretentious grain is much cultivated under the name Raggi, and furnishes the poor people a valuable food-supply. In Japan it is quite subordinate to the two already mentioned (Awa and Hiye), so that you might wander through the country for days together without meeting it. I found it in Echigo, after harvest, where its short stalks had been left standing and only the tops, with their three to five ears standing together finger-fashion, cut off. I discovered it also in Kaga, where the peasants called it Kamoashi and Kamo-mata-kibi. They preferred its meal to Ko-mugi-no-ko (wheat-flour) for small dough-cakes. In other places I heard the name Sankaku-hiye, three-cornered (three-edged) hiye, which refers no doubt to its three-edged stalk. In Thunberg and Kaempfer are to be found the Japanese terms, Kokusa and Nanban-kibi, *e.g.*, Barbarian millet.

8. Guinea corn or Durrah, Japanese Morokoshi (*Sorghum vulgare*, Perse ; *Holcus sorghum*, L.); called also Taka-kibi (high millet), is of only small importance for Japan. This grain is seldom found except along the borders of fields, encircling them in a furrow ; and even this but rarely. It is raised in April, in a seed-bed. Later, having attained a height of about 15 cm., it is transplanted at intervals of from 25 to 30 cm. It is harvested in September. The same holds good for the long-panicled form, the broom-corn, so often grown in Northern Italy, and of whose panicles brooms are also made in Eastern Asia.

9. Job's tears, Japanese Dzudzu-dama and Yokui-nin (*Coix*

lacryma Jobi, L.). This grain, which is diœcious and related to maize, is found almost always near houses, in small moist beds. Its white seeds, which are nearly globular and hard, are used, not so much for food, as for making Buddhist rosaries, and even these only exceptionally. I do not know whether the tear-grass is used in Japan to make mats, as in Canton. (See Scherzer.)

10. Maize (*Zea Mais*, L.) is called Tô-moro-koshi, Tô-kibi, Satsuma-kibi, and Nanban-kibi by the Japanese. Of the three great gifts which the New World offered the Old in the sixteenth century, tobacco was most joyfully received, and found the quickest entrance and dissemination among the nations of the earth. Maize followed it, and then the potato. This last did not begin its eastern journey till late, and advanced slowly, only winning warm friends, outside of Europe, among the Maoris of New Zealand. Maize, in its half-ripe condition, on the cob, offered a ready food, quickly and easily prepared by boiling or roasting, with a sweet taste, which is more pleasing to the people of Africa and Asia than the stronger flavour of our common potato. This explains its more rapid spread in favourable climates.

An additional reason is, that, with its various sub-species, it accommodates itself within a wide zone to manifold conditions of climate and soil, from the equator to latitude 50° in North America, as in Europe, and to the fortieth parallel in the southern hemisphere,—from the hot, damp shores of Eastern Mexico to the plateau of Anahuac and the plain of Utah, where its cultivation is only rendered possible by irrigation.

Like rice, maize is a summer growth—more modest, it is true, than the latter in its demands for warmth and moisture, but yet more dependent upon them than are our European cereals. To develop and ripen its grains, it requires a mean summer warmth of at least 15° C. But to flourish, it must have also a bountiful supply of water, natural or artificial, for its deep-growing roots. Hence its cultivation is restricted—in the Mediterranean basin, for example, almost entirely to its northern side, where, as in the valley of the Po, there is no lack of rain in summer. On the other hand, some of its sub-species, with a short period of vegetation (three months, instead of five or six), reach in America quite to the Red River of the North, the southern tributary of Lake Winnipeg. The climate there is, I suppose, harder than that of Northern Germany ; but with a greater rain-fall in the short, warm summer, and an extremely fertile virgin soil, the development and ripening of maize is sufficiently fostered, as is not the case in Thuringia, say, under almost the same parallel.

On the discovery of America, Columbus found maize, among other things, cultivated in Hispaniola, and later by the Indians at the various points on the mainland where he touched. The Carib term Mahis was adopted and changed to maize. To this day maize flourishes best in American soil, where, according to Alexander von Humboldt, it returns in some places harvests of three-hundred fold. Moreover, the greatest number of sub-varieties are found in America (over sixty); a point of no little significance in answering the question as to its origin. Many of these, too, lose their character when transplanted to other countries. In the fertile Central States of the Union—Iowa, Illinois, Indiana, Ohio, Tennessee, Kentucky, and Missouri, its strong roots find abundant nourishment in their deep alluvial soil and copious summer rains. Maize-culture has therefore acquired an extent and significance unequalled anywhere else in the world.

As the various Teutonic nations bestow the word corn upon their principal grain,—the German on rye, the Swede on barley, the Englishman on wheat,—so the North American calls maize "corn," or "Indian corn," in proper recognition of its value.

Its cultivation, as already remarked, spread rapidly over the Old World, and first to the three great peninsulas of Southern Europe, from west to east successively, but gained no real foothold except in the countries adjoining on the north, particularly in the valley of the Po and the lands of the Lower Danube. In the former, *polenta,* prepared from Indian meal, became a national dish; in the latter, among the Roumanians, mamaliga, a cake made from the meal of Kukuruz (maize).

From the lands of the Lower Danube, maize-culture spread to the fertile Ukraine, and has since then been a competitor there with wheat. The Portuguese spread it, as well as tobacco, with their naval supremacy, along the coasts of Africa [1] and Southern and Eastern Asia. Its introduction followed their first landing, in China in 1517, on the Philippine Islands 1520, in Japan 1542, though perhaps not immediately.

Different authors have disputed whether this was really the course of the advance of maize in Eastern Asia. Von Siebold believed he had discovered maize-cobs on an old Japanese coat-of-arms, and had found other proofs of a very ancient cultivation of Zea maize in China and Japan.[2] The French *agronom* Bonafous, also, to whom we owe the most complete work on maize,[3] doubts whether Eastern Asia became acquainted with maize until after the discovery of America. The same was the case again in more recent

[1] In Dapper: "Beschreibung von Africa," published by Jacob von Meurs, 1670, we find, p. 457: "Erstlich hat man den Reis, als auch den Türkischen Weitzen, den die Indier Mays nennen, und die Portugallier am allerersten aus Westindien, da er überflüssig wächset, auf der Insel des heiligen Thomas, und von da auf den Goldstrand gebracht, und den Schwartzen mitgeteilet. Dan vor der Portugallier Zeit war ihnen dieses Gewächse unbekant: aber itzund wächset es bey ihnen überall in grosser menge. Auch backen sie Broht darvon, darunter sie zuweilen Hürse, zuweilen keine menge."

[2] "Ex antiquis temporibus in insulis Japanicis cultum frumentum." See "Synopsis Plantarum Œconomicarum Universi Regni Japanici," in "Verhandlingen van het Batavisch Genootschap," XII. Bat., 1830.

[3] "Histoire nat., agric. et économique du Maïs." Paris, 1836.

times with the interpreter of the English embassy in Pekin, W. F. Mayers. Both base their view, that maize was known in China before the discovery of America, chiefly on the Chinese work "Pen-tsao-kang-mu," the well-known Materia Medica of the Chinese, which contains an undeniable representation of our plant. But Li Shi chen (Tung pi), the celebrated author of that work, compiled it in the twenty-six years from 1552 to 1578.[1] This then does not at all contradict the view that maize did not come to Eastern Asia till after America was discovered. This view has been repeated and most convincingly established by the famous Genevan botanical geographer, A de Candollė,[2] so that to take up the subject again would seem almost unnecessary. There are, however, other proofs, to my mind more direct, of my statement that maize was introduced into Eastern Asia by the Portuguese—proofs which De Candolle did not use, though among other things, he correctly stated that maize has no Sanscrit name, and is mentioned neither by Marco Polo nor Mendez Pinto.

Then too, as Von Siebold also mentions, it is a significant fact in this connection, that Japan raises only two sorts of maize. Now, it is highly probable that a larger number of sub-species would have been developed in the case of such an old culture, as of almost all other fruits of the field. Further, it must be emphasized that now-a-days this corn plays only a very subordinate *rôle* among the other nutritious plants of the country, its cultivation being restricted to the borders of fields and to solitary beds, and never extended over wide stretches. Also its grain is used only for a few weeks in summer, when the green ears are roasted over burning coals and then eaten. But this is a street custom in various parts of the East. Considering the conservatism of Japanese agriculture and its adherence to fixed methods, we may take for granted that there has been little change in the use of this grain since its introduction, and that it never was an important part of the country's agricultural products. But a weightier and more convincing reason for thinking that the culture of maize in Japan is not old, but was introduced by the Portuguese, is the fact that Indian corn has no proper Japanese name. All other plants,—those brought over from China no less than most of the indigenous ones,—have such names. But all the designations for maize already mentioned are borrowed names, which clearly indicate a foreign origin for this grain. Thus the term "Tô-morokoshi" means Chinese sorghum ; Tô-kibi," Chinese millet, and "Nanban-kibi," millet of the southern barbarians. Moreover, the Chinese in Formosa call maize "Fan-meh," that is, foreign grain—an expression they certainly would not have employed if the thing itself had been known to them in their mother-country

[1] Bretschneider : "Botanicum Sinicum," p. 55.

[2] A. de Candolle : *a.* "Bibliothèque universelle de Genève," août, 1836. *b.* "Géogr. bot. raisonnée," p. 942. *c.* "L'origine des plantes cultivées," pp. 311–319.

The words "Fan," foreign, and "Nanban" (pronounced Namban), that is, southern barbarians, point to Europeans coming from the South, especially the Portuguese; for they, above all, were called foreigners and "Nanban." The expressions "Tô-morokoshi" and "Tô-kibi" are no less easily understood, however, than "Welschkorn" (Italian Corn), and "Türkischer Weizen" (Turkish wheat) to-day. The Germans became acquainted with maize through Italy and Turkey, and therefore call it after these countries. The same is true of the Japanese with regard to maize, as coming from China. The grain came from that country, and was also, in part, like tobacco, brought directly by the Portuguese, in the period of Tenshô (1573–1592 A.D.), at the time of Hideyôshi.

11. Buckwheat (*Fagopyrum esculentum*, Moench; *Polygonum Fagopyrum*, L.), Japanese Soba. The home of this plant, which is spread throughout the northern temperate zone, seems to be Mantchooria and the neighbouring regions of Central Asia, where, according to Maximovicz, it grows wild.[1] From here it was early carried over the north-eastern monsoon region, and in the middle ages across Western Asia to Europe by Mongolian and Turkish-Tartar peoples. As to its cultivation and use, buckwheat is related most to the millet varieties. Like them, it is principally a summer growth; like them, it is satisfied with light, sandy soil, and furnishes in its seeds a meal which is made, in a similar fashion, into soup and broth. This meal, however, is also used to make little cakes, though not in the form of the "Blinies" so much relished by Russians, and the buckwheat cakes of North America. These are unknown in Japanese kitchens, in which another method of preparation prevails.[2] As with us, buckwheat in Japan blossoms in late summer and autumn. Its harvest is in October. It is also raised as a winter crop, though rarely.

(b) *Pulse, or Leguminous Plants.*

The agricultural products included under this general name come undoubtedly next to grain in range and importance. In their high proportion of protein, and in nutritious value, they far exceed all other sources of vegetable food, and resemble eggs. Alone, or with eggs and fish, they take the place of meat for many millions of the earth's inhabitants, especially in Eastern Asia. They are called by the Japanese, Mame, a name which is applied especially to various kinds of beans, the most important and widespread representatives of the family in Japan. Their use is more diverse than in most other countries. When boiled, they furnish

[1] Maximowicz: "Primitiæ floræ Amurensis." St. Petersburg, 1859.

[2] "E farina hujus placentæ rotundæ, sæpe coloratæ, coctæ in usum peregrinantium, in omnibus tabernis venales extant."—Thunberg, "Flora Japonica," p. 169.

a favourite relish to the rather insipid water-cooked rice and millet, and other starchy grains. Some of them also serve in preparing sauce, vegetable jelly, and other things known under the names Shôyu, Tôfu, and Miso, and much used in Japanese housekeeping. With the exception of peas and broad beans, all the plants in this group are raised only in summer, because the winter of Japan is too severe for them. In the case of the latter, terrace-cultivation is general; of the former, cultivation in rows.

There are grown in Japan:

1. The ground-nut, Japanese Rakkuwashô (pronounced Rakkashô), and Tô-jin-mame, that is, Chinese bean (*Arachis hypogæa*, L.) It is planted only in the warmer southern parts of the country, and over a small territory. Sometimes it is roasted and eaten, at others, made into oil. (See further under oil-plants.)

2. The soy-bean, Japanese Daidzu and O-mame (*Glycine hispida*, Moench.; *Soja hispida*, Miq.; *Dolichos soja*, L.), was introduced into our botanical gardens nearly a century ago.[1] But it did not receive much attention from us till after the Vienna Exhibition. There is now scarcely a European country in which attempts to raise it have not been made; within the last ten years, scarcely a journal of horticulture or agriculture which has not pictured or described it.[2] In France and Austro-Hungary especially, much attention has been paid to the soy-bean during this period; and its cultivation has been attempted in many places, with greater or less success.[3] The results of these studies and experiments in Austria have been recorded in an interesting work by Prof. Haberlandt, through whom principally they were undertaken, in and on behalf of the imperial high-school of agriculture, with seeds from China, Japan, and Mongolia.[4] These results seem to establish the fact that the soy-bean can be raised in a temperate climate, and to bear witness to its great productiveness, its extraordinary nutritiousness, and the various other qualities for which it is celebrated. They thus possess a manifold interest. Among the pulse of Japan (and not less of China), the soy-bean ranks first in extent, variety of use, and value; and chemical analyses prove the empirical judgment to be well founded.

In point of nutriment, the soy-bean is of all vegetables the nearest to meat. It contains nearly two-fifths of its weight in legumin rich in nitrogen, and nearly one-sixth in fat. The soy-bean is to the inhabitants of Japan what their *garbanzos* (chick-peas) are to the Spanish, and their *feijão preto* (black beans) to the Brazilians. But chick-peas are only served as relish and garnishing to meat,

[1] In the "Hortus Kewensis" of Ait. the year 1790 is given as the date of its introduction into England.

[2] See also De Candolle: "L'Origine des Plantes cultivées," p. 265.

[3] As good representations of the soy-bean, I may mention that of E. Kaempfer, 1880, pp. 154 and 185.

[4] "Die Sojabohne." Vienna, 1878.

while Daidzu serves as a substitute, being, indeed, in a certain sense, oil and spice to the insipid, starchy rice and the barley or millet porridge with which it is eaten.

The numerous varieties of the soy-bean grow on fine, leafy bushes from 0·50 to 1·00 metre high, with many and regular twigs. The number and extent of its branches correspond to strength of trunk and root. Among further distinctive features of the plant is its abundant foliage of large triplet leaves, which appear at the numerous internodes. But still more distinctive is the thick reddish brown hair with which pods, leaf-stalks, the upper surfaces of leaves, and even twigs are covered.

The axes both of trunk and branches in the black-seeded species have a marked tendency to wind, but do not require props. This winding is much less noticeable with the stiffer stems of the pale yellow and reddish brown varieties. At every higher whorl of leaves there is developed a little cluster of blossoms. The blossoms themselves are plain-looking, like those of lentils, in colour a white lilac or pale violet. They are followed by rich growths of fruit, which, with the development of blossoms, continue from the middle of summer till late autumn, when night-frosts usually bring them to a sudden end.

The pods, roughly haired and hanging, appear mostly in pairs, though often in threes and fours on a common stem. They have short stems and are short and cylindrical themselves. They end in a beak and have as a rule two seeds, with a strongly-marked division between them, as Kaempfer's picture shows. However, among some species there are many pods of three and four beans and sometimes these outnumber the others. Its great need of light and warmth being supplied, a single soy-plant in proper soil, will, according to Haberlandt, put forth two hundred pods, on an average. In regular field cultivation, the crop is, of course, much smaller. Attempts at cultivation in Austria up to 1878 gave widely divergent results, from 680-fold down to a total failure of the crop in consequence of long-continued wet, cold weather. Haberlandt put down at 73-fold the average produce of 1877, after a summer of rain and low temperature. But the crop-returns of China and Japan by no means agree with this. In the latter, for example, according to Scherzer, six Shô of seed-beans of the early-ripening Shiro-mame are credited with a crop of 120 Shô on 300 Tsubo of land. This means a harvest of only 20-fold, or, taking account of seed lost in sprouting, about twelve pods of two beans each to every plant.

In Japan the varieties of soy-bean are distinguished—according to colour, as white (more properly yellowish), black, brownish red, green, and spotted; according to duration of growth, as early-ripening, middle-ripening, and late-ripening; according to form, as spherical, ellipsoidal, kidney-shaped, and compressed laterally; according to use, as those which serve principally in making Shôyu (soy), Tôfu (bean-cheese), and Miso (a sort of sauce), and those eaten in any plain shape.[1]

(α) White (pea-yellow) soy-beans, Japanese Shiro-mame or Haku-daidzu. To this division belongs an early-ripening sort with very small seeds, called Goguwatsu-mame, or "five-months-kind," because it ripens in the fifth month of the old Japanese calendar, our July; also another small-seeded, early-ripening variety, the Wase-mame or Natsu-mame, that is, early and summer-bean. These two are also called Tôfu-mame, because they are used chiefly in making Tôfu. Another sort serves to produce Miso. It is called Nakate-mame, "middle-late bean," its time of maturity occurring half-way between that of the early and late kinds. Its seeds are round and somewhat larger. The late-ripening varieties, Okute-mame (late-bean), Maru-mame (bullet-bean), and Teppô-mame (gun-bean), or Aki-mame (autumn-bean) have, as their names indicate, mostly bullet-shaped seeds, which become harder and larger than the early ones. The variety last named is used in making Shôyu, while Maru-mame is valuable as horse-feed.

(β) Black soy-beans, Japanese Kuro-mame or Koku-daidzu. These are eaten boiled, with sugar, as an *entrée* or as a relish to rice. There is a middle-late sub-species with round, elliptical seeds, Kuro-mame, in short, and another like it, with big, bullet-shaped beans, called Kuro-teppô-mame. And again there is a late-ripening sort with flat, elliptical seeds under several names.

(γ) Brown soy-beans, Japanese Katsu-daidzu (thirsty soy-bean) are much less grown than the white and black sub-species, and are used like the latter. They are distinguished as Aka-mame, red soy-beans, round, of red-brown colour, in different varieties, and Cha-mame, tea-beans, three light-brown sorts of small extent and significance.

(δ) Greenish or bluish green soy-beans, Japanese Aö-mame or Sei-daidzu, are eaten mostly boiled and with sugar, like the black and brown-red varieties. And, with the brownish sorts, they are much less widely grown than the black and yellowish. The Japanese distinguish the following sub-species of Aö-mame :—

a. Sei-hito,—epidermis green, inside a whitish yellow.

b. Nikuri-sei,—greenish throughout. Both sub-varieties run from roundish-ellipsoidal to a bullet roundness, are of medium size, and remind one of green peas.

c. Kage-mame, with pale green, round beans.

(ϵ) Speckled soy-beans, Japanese Fuiri-mame or Han-daidzu. This group is not important. Its cultivation is confined to a small area, in a few provinces. Its sub-varieties are known as :—

a. Kuro-kura-kake-mame, with a black spot on the saddle (eye), otherwise greenish; flat and with the outline of an egg.

[1] I doubt the spontaneous appearance of the soy-bean in Japan, although it is asserted in several works on the flora of that country.

b. Aka-kura-kake-mame, with a brown spot on the saddle (eye), otherwise yellowish-green, flat and drawn out long.

c. Fuiri-mame or Udzura-mame, speckled or spotted soy-bean, yellowish-green with many dark flecks. A rare variety, grown only in a few places, especially in Harima.

Early-ripening soy-beans are sown as early as April in Southern Japan, in Central Japan during May. Those that ripen in autumn need much more warmth, and are sown, as a rule, one month later. In mountain-districts, land is often chosen which has lain fallow all winter, or wheat and barley-fields are taken. The soy-beans are here planted in terraces, being put into holes beside the stalks of ripening winter grain. Hence, when this is harvested, the pulse needs only to be hoed and manured. Late-ripening Daidzu is also a favourite for planting along the edge of fields and on the new-built dykes of rice-fields.

With its thick foliage, the soy-bean needs more light and warmth than our pulse. If air and light are denied it, the blossoms and fruit are scanty, and without the required warmth, the latter does not ripen. The shade of tea-bushes in Eastern Asia, and of grape-vines with us, is sufficient to diminish considerably its fructification. It is therefore not profitable to plant it in tea-gardens and vineyards. For the same reason its seeds should be planted far apart, from four to fifteen in a square meter.

It has been found that the early ripening sorts require an average warmth of from 20° to 30° C., according as they are sown at the beginning or in the middle of May. This varies not merely with the sub-species, but also according to the time of sowing, inasmuch as a delay in the latter until the middle or end of May brings about a quicker development and a shortening of the period of vegetation, in the higher temperature of air and soil that then prevails. These early-ripening sorts flourish farther north even than the limit of successful maize-culture. The others are prevented by the first frosts from reaching the natural conclusion of their growth, for their blossoms and unripe pods die when the temperature falls below −2° C.

At the end of his above-mentioned treatise, Haberlandt summed up in five noteworthy propositions, the results of his experiments with the soy-bean and of its chemical analysis. His conclusions are as follows :—

(*a*) The acclimatization of the early-ripening sorts, particularly those with yellow and reddish brown seeds, appeared to have fully succeeded in Central Europe.

(*b*) The seeds obtained were larger, heavier, and handsomer than those from Eastern Asia, the chemical composition, however, remaining unchanged.

(*c*) The soy-plant resists light spring frosts better than our young beans, and endures greater dryness in summer than most leguminous plants, though otherwise much like other kinds of beans.

(*d*) It is distinguished by heavy crops, besides furnishing, in its stems and leaves, either green or dried, a nourishing feed, of which cattle are very fond.

(*e*) In their high percentage of protein and fat, they far excel all other pulse in nutritive quality; and when properly prepared are second to none in flavour.

After such favourable judgments, it might have been expected that the soy-bean, at least in the warmer regions of Austro-Hungary, would soon become popular and generally cultivated. The result, however, was quite otherwise. The hopes which he had aroused in behalf of this plant seem to have disappeared with Haberlandt, who died in 1878.

As I know from a reliable source,[1] people soon became convinced that it was possible to cultivate with certainty the early-ripening yellow sorts. The crops from these, however, are unsatisfactory. It is so difficult to boil them soft that they have no sale and cannot be turned to due account.

In view of the interest attaching for all these reasons to the cultivation and use of *Glycine hispida* in Japan and neighbouring countries, I introduce two tables at the close of this section, the first giving several analyses of it and of its straw, the second a view of its chemical composition as compared with other leguminous plants.

3. Ray-fruited dwarf-bean, Jap. Adzuki (*Phaseolus radiatus*, L.). Kaempfer gives an excellent description of this, a variety that is always provided with hairs on stalk and leaf. Its short petioles, springing from the base of the leaf, form a cluster of yellow blossoms, followed in turn by from four to six hanging pods, either spread out in wheel-shape or drawn together to a head. These pods are cylindrical. The beans are no larger than small peas, but shaped like a blunt ellipsoid, smooth and shining, and greatly differentiated according to colour and size. Since the Adzuki have a better taste than most other leguminous plants, their cultivation and consumption have always been more extensive throughout the whole monsoon region—in fact, second only to the soy-bean. The numerous sub-species are grouped by Salvatier[2] as follows:—

(*a*) *Typicus.* Umbellated pods, horizontally flattened, and covered with red or black hairs. To this division belongs Adzuki or Oku-adzuki (large adzuki) with relatively large, brownish red beans.

(*b*) *Pendulus.* Pods smooth or set with short hairs, and hanging in sets of four, two opposite two. The following varieties are worthy of notice here.

α. Kuro-adzuki, black-fruited adzuki.

β. Shiro-adzuki, white-fruited adzuki. The colour is no more

[1] According to written information, kindly furnished by Prof. von Liebenberg, of Vienna.

[2] "Enumeratio Plantarum," etc.

white than in the case of the Dolichos. They are yellow, like many peas, which at first glance they appear more to resemble than beans, though smaller and of attenuated shape.

γ. Tsuru-adzuki, twining Adzuki.

(*c*) *Subtrilobatus*, Jap. Bundo and Yayenari, each having from four to six cylindrical, hanging pods.

4. The Japanese sword-bean, "le haricot du Japon," Jap. Nata-mame (*Canavalia incurva*, D. C.; *Dolichos incurvus*, Thunb.), a kind of climbing bean with somewhat large, pink blossoms in simple clusters. Leaves three-cleft, as with all species of beans; the leaf-divisions oval, pointed, smooth. Pods hanging, curved somewhat like a sword, thick, broad, and often 20 cm. long, with large beans. In the case of one variety, they are pink (Aka-nata-mame); of another, white (Shiro-nata-mame). The young pods are cooked with the beans or eaten pickled.

5. Coast sword-bean, Jap. Hama-nata-mame (*Canavalia lineata*, D. C.; *Dolichos lineatus*, Thunb.), growing wild in several reaches of the southern coast; seeds little used.

6. The common bean, Jap. Ingen-mame (*Phaseolus vulgaris*, L.), is also cultivated in the climbing form, though mostly as a dwarf-bean. But it is evident from its small number of sub-species (not more than twelve or fifteen) that its cultivation has not the antiquity, and certainly not the importance, which it has in many other countries. The seeds are generally eaten when ripe, though sometimes with the young pods.

7. *Phaseolus multiflorus*, L. The scarlet-runner is mentioned by Kinch, but without native names. It appears to have been only lately introduced, as no older botanist refers to it, and I have never come across it.

8. *Phaseolus Mungo*, L. I noticed beans of this kind, probably the smallest of all, in the Kew collection from the Japanese division of the Vienna Exhibition, with the note, "Used for food in Japan." How far this is the case, I cannot say, nor do I find them elsewhere mentioned as Japanese.

9. Vigna Catjang Walpers (*Dolichos Catjang*, L.).

10. Pachyrhizus angulatus, Rich. (*Dolichos bulbosus*, L.). Of both these kinds, which I also saw in Kew as from Japan, the same thing is true as of No. 8.

11. Umbellate-blossomed dolichos-bean, Jap. Sasage or Sasagi (*Dolichos umbellatus*, Thunb.). The stalk, which is sometimes a climber, puts forth from the bases of its leaves long blossoms. These umbels are followed by as many long, slender, cylindrical pods with small seeds. The latter are eaten sometimes ripe, sometimes with the green pods. There are also a number of sub-species belonging to this species, which are distinguished and named partly after the colour of their beans, and partly after other features; Midori-sasagi, Haku-furô-sasagi, Hata-sasagi, Adzuki-sasagi Yekko-sasagi, etc.

12. Megane-sasagi (*Dolichos bicontortus*, Durieu), lately introduced from France.

13. Kidney-bean (*Lablab cultratus*, D. C.; *Dolichos cultratus*, Thunb.; and *D. ensiformis*, Thunb.). The different forms of this bean, which has sometimes white blossoms, sometimes red, are named in Japan Sengoku-mame, Fuji-mame or Azi-mame, Shirohana-azi-mame, and Hira-mame. They are distinguished from dolichos-beans proper by the fact that the blossoms grow like ears of corn, and also by their pods, which are short, like those of peas.

The seeds of certain wild kinds of beans also serve for food. They are: Tankiri-mame (*Rhynchosia volubilis*, Lour.; *Glycine villosa*, Thunb.), No-adzuki (*Atylosia subrhombea*, Miq.), Tsuru-mame or No-mame (*Glycine soja*, S. and Z.), No-sasage or Karasu-mame (*Dumasia truncata*, S. and Z.).

14. Peas, Jap. Yendo (pronounced Endo), Endo-mame and Nora-mame (*Pisum sativum*, L.). Three chief varieties of this species are cultivated, viz., first, the typical, white-fruited, which, as a rule, is eaten with the pods (Saya) while still unripe, Saya-endo, and secondly, the sub-species, *P. s. thebaicum*, Alefeld (Königsberg dice-pea) with grey-green seeds (Midori-endo) or with brownish red (Aka-endo). The latter predominates. They are all, moreover, cultivated pretty frequently; are sown in November, and harvested in May.

15. Broad-bean, Jap. Sora-mame (*Vicia faba*, L.). This also is a winter crop, being sown in October and harvested in June.

As in the Mediterranean region, the ripe beans are usually shred and used as horse-feed; but they serve also as food for men. They are not so extensively cultivated as in many other countries.

ANALYSES OF SOY-BEANS (GLYCINE HISPIDA, MOENCH).

	I. Jap. beans.	II. Jap. beans.	III. Jap. beans.	IV. Seeds.	V. Empty Pods.	VI. Straw and Leaves.	VII. Yellow.	VIII. Red Brown.	IX. Black.	X. Red Brown from S. Tyrol
							Beans from Vienna.			
Water . . .	6·91	12·88	11·32	14·00	14·00	14·00	8·1	9·4	9·9	10·1
Protein . .	38·29	35·00	37·75	32·32	4·64	6·08	36·8	31·6	31·2	38·1
Fat	18·71	15·60	20·89	16·76	1·29	2·03	17·6	17·4	18·1	17·8
Extractive matter free from N.	26·20	29·92	24·18	26·56	41·87	37·12	?	?	?	?
Raw fibre .	5·33	4·40	2·00	5·57	30·45	22·97	4·8	4·3	4·2	?
Ashes . . .	4·56	4·20	3·86	4·76	7·79	9·31	5·4	5·1	4·8	5·2
	100·00	102·00	100·00	99·97	100·04	91·33	72·07	67·8	68·2	61·2

Remarks:

Of these analyses, I., IV., V., VI., VII., VIII., IX., and X. were taken from Haberlandt's "Die Sojabohne." The last four originated with Mach; IV., V., and VI., with Caplan; I., with Senff.

Analysis II. was made by Levallois of the Inst. Agronomique in Paris, and is taken from the "Revue horticole"; III. is traceable to Kinch, and is found in the "Transact. Asiat. Soc. of Japan," viii., p. 398.

COMPARATIVE TABLE OF ANALYSES OF VARIOUS PULSE.

	I. Glycine hispida (Daidzu).	II. Phaseolus radiatus (Adzuki).	III. Canavallia incurva (Nata-mame).	IV. Phaseolus vulgaris (Ingen-mame).	V. Pisum sativum (Yendo).	VI. Vicia faba (Sora-mame).	VII. Ervum lens Lentil.	VIII. Lupinus flavus Yellow Lupine.	IX. Arachis hypogæa. Ground-nut.
Water	6·91	16·08	13·3	15·0	13·92	16·16	13·4	12·61	6·3
Raw Protein .	38·29	17·75	21·7	26·9	22·72	24·88	24·0	35·32	28·2
Fat	18·71	0·34	1·6	3·0	2·01	1·67	2·6	4·97	41·2
Extractive matter free from N.	26·20	48·10	47·7	48·8	54 27	47·16	49 4	29·17	7·2
Raw Fibre . .	5·33	14·96	11·8	2·8	4·51	6·85	6·9	14·15	13·9
Ashes	4·56	2·77	3·7	3·5	2·57	3·28	3·7	3·78	3·2
	99·90	100·00	99·8	100·00	100·00	100 00	100·00	100·00	100·00

Of these analyses, I., IV., V., VI., VII., and VIII. are taken from Haberlandt's "Die Sojabohne;" II., from Dwars in "Transactions Ass. Soc. of Japan," vol. vi.; III. was calculated after an analysis of Kellner in Nobbe's "Landwirthschaftliche Versuchsstationen," vol. xxx., 1884; IX. is traceable to Wolff, and is taken from Ollech's: "Die Rückstände der Oel-fabrikation," because it turns out, through comparison with the soy-bean and the other starchy leguminous plants, that fat represents, to a certain degree the hydrates of carbon.

(c) *Starch-producing Bulbs.*

Under this head we shall consider all of the so-called "Root-crops" (*Hackfrüchte*) which are raised for the sake of their starchy bulbs or roots, and also all uncultivated plants which in similar manner are useful as food in Japan on account of their containing starch; hence all kinds of potatoes and their substitutes, called collectively Imo. The number of species in this group, and the variety of its forms which are rich in meal and grow underground, are greater than in most other countries. Undoubtedly the oldest inhabitants of Japan derived an important food-supply from wild, though often valuable, species; but in the course of time there was added to these a number of others, some from China, some from the Malay archipelago. The growth and consumption of these foreign species were peculiarly favoured by circumstances of climate, or else were developed as the results of particular tastes.

The Japanese prefer above all the sweet bulbs of several Araceæ, especially the Taro, and also the Batate. They are therefore more largely cultivated than all the others. To follow, however, the natural order, let us here consider:

1. The lotus-plant, Jap. Hasu and Renge (*Nelumbo nucifera*, Gaertn.; *Nelumbium speciosum*, Wild.; *Nymphœa nucifera*, L.). Its home is the Indian monsoon-region, where it was first sacred to Siva, then to Buddha. It is difficult to determine whether Buddhist priests transplanted it thence to the countries of Chinese civilization, or whether it was already indigenous there. As far as Japan is concerned, I incline to the former supposition. It is certainly never found growing wild, either in China or Japan. On the contrary, it is often planted in ponds, partly for the sake of its magnificent blossoms, partly to obtain its edible rhizome, called Renkon in Japan, or on account of its oily nuts.

Its cylindrical white rhizomes attain a considerable length, and a thickness of from 8 to 12 cm. They lie far down in the mud. They are divided by constricting fibres into long fingers, which when cut across disclose a very porous substance permeated by numerous concentric canals.[1] These rhizomes contain a tolerable amount of starch, and are boiled and eaten in considerable quantities. To Europeans their insipid mealy taste is not agreeable; but the Japanese and Chinese think a great deal of them, chiefly because they consider them very healthy, being easily digested by children and old men. (For *Nuphar japonicum* and *Nymphœa tetragona*, see the chapter following.)

2. Arrow-head, Jap. Kuwai (*Sagittaria sagittæfolia*, L.). This plant does not follow in the botanical system, but by the nature of its cultivation and use it does. In China, too, the arrow-head is grown in ponds as a food. Its rhizomes form white, spherical protuberances, which, when boiled, taste like chestnuts (water-chestnuts). The starch prepared from them is said to be used in China like arrow-root.

3. Ôgi (*Hedysarum esculentum*, Led.). Like the two kinds that follow, this papilionacea is not cultivated, and is of no great consequence in Japan as a source of food. The tubercle produced by it (I had an opportunity of seeing it only once) outwardly resembles truffles. As noted by Gmelin in his "Flora Sibirica," the plant prefers stony places, as, for example, in Japan, the slopes of Fuji-san. Its proper home is Siberia, where it is much eaten by the Samoyedes.

4. Hodo, or Hodo-imo (*Apios Fortunei*, Maxim.). Found in con-

[1] According to Herodotus, II. 92, the edible root of the Egyptian lotus was round, and about the size of an apple. If his statement is correct, the plant must have been some other Nymphæacea, but was certainly not the same as the lotus of the monsoon-region, with which we are concerned here.

siderable quantities in bushy or wooded regions, and on mountains; forms a tuber more spherical than pear-shaped, which is mealy when boiled and is good for food.

5. Kudzu (*Pueraria Thunbergiana*, Benth.; *Pachyrhizus Thunbergianus*, S. and Z.). This plant is of frequent occurrence, especially on the edges of forests and among bushes, through which its long tendrils twine. Its thick roots furnish a starch meal, which is used for food.

6. The batata, or sweet-potato, Jap.: Satsuma-imo or Riukiu-imo (*Batatas edulis*, Choisy; *Convolvulus Batatas*, L.; *C. edulis*, Thunb.). The cultivation of this important vegetable has spread over the greater part of the tropical and sub-tropical regions of the earth. In Europe and North America its territory adjoins that of our common potato on the south, for example in Andalusia and the Gulf States, whose long-continued high temperature in summer is quite sufficient for it. As to its origin, opinions still differ, but there are strong arguments in favour of South America. It was undoubtedly not brought to the eastern monsoon-region till after the discovery of the New World, a fact that is proved not only by the names here applied to it, but also by historical dates. In the Malaccas it is called batata, as in Portugal, though on the Philippines it is named Castillian.

About the year 1610 the cultivation of the batata reached China from Luzon; from here the Riukiu Islands,[1] where it is called Kara-imo (Chinese potato) and is the principal food of the inhabitants. They took up with it at once, and have cultivated it ever since. They were proud of possessing a precious vegetable that was unknown to their northern neighbours. In 1698 their king presented the Daimiô of Satsuma with a basketful of batatas, which the latter planted on Tanega-shima. From this point their cultivation spread over the whole lordship of Satsuma, and then further over all the warm parts of Southern and Middle Japan. Thus it has come to pass that the batata is called Riukiu-imo in Satsuma, and Satsuma-imo in all the rest of the kingdom of Nippon. Only a hundred years ago, however, the cultivation of this vegetable, even in southern parts of the country, was so limited that its bulbs seemed rare dainties to children. Their sweetish flavour reminds one of edible chestnuts. They contain only 16 per cent. of starch. The credit for its propagation belongs chiefly to a certain Aoki Kongô, to whom the batata-dealers of Tôkio, about fifteen years ago, erected a monument in the neighbouring Meguro.

The smaller bulbs of the Satsuma-imo, which are used in Japan for propagation, are planted, in spring, in loose, well-manured ground. They are arranged in rows and at intervals of from 50 to 60 cm. During the first two months, their young sprouts are watered several

[1] I am chiefly indebted for the remarks here following to my old friend, Ito Keiske, of Tôkio.

times with fluid cesspool manure. In some neighbourhoods, in June, the trailing tendrils, now from 2 to 2½ m. long, are trimmed, and the cuttings are transplanted for further increase into a freshly-prepared field from which wheat has just been reaped. Each plant produces five or six bulbs, differing greatly in size and shape.

The commonest and most popular sub-species is a red-skinned variety (Aka-imo) in the form of an ellipsoid. There is one variety of this again which is more in the shape of a club, and so on to spherical. This sort grows to the size of Kohl-rabi root.

Like most climbers, the batata prefers a light, warm soil. Its shoots sprawl out in all directions to a length of two to four meters, with many long-stemmed leaves. The latter somewhat resemble those of the ivy, though larger and with greater variety of form, being found sometimes heart-shaped, and again indented, but generally with three or five lobes.

One of the peculiarities of batata bulbs, is the fact that they are fleshy swellings of side-roots, and not underground tubers in the ordinary sense, like potatoes proper and Taro, nor yet rhizomes, like the well-known purgative products of other *convolvulaceæ*.[1] Where the ground is not sufficiently heated through, as in Germany, the batata does not develop these root-swellings at all, or at most deposits only a little starch in them. This was proved, also, in attempts at cultivation which I made with several West Indian sub-species, eighteen years ago in the Botanical Garden at Frankfort-on-the-Main. The parts above the surface developed splendidly, and covered the ground with a thick carpet of creepers and leaves. But in autumn, when we sought for bulbs, we discovered that the greatest root-swellings had only reached the thickness of one's thumb.

7. The common or Irish potato, Jap. Jagatara-imo (*Solanum tuberosum*, L.). The Japanese name, Jagatara, is a somewhat uncouth form for Jacatra, the earlier designation for Batavia, and points to the introduction of the potato through the Dutch Company. I could learn no particulars as to when this happened. In the plains and valleys of Japan, where batata or Taro can be raised, we very seldom meet our potato, though we find it in the mountain-districts of Kiushiu as far as Yezo, and pretty frequently too; but even here not in large fields. Theydo not understand how to manage the plant, not giving it proper manure, nor digging ridges about it, and consequently get but scanty crops—about five-fold. In fact, the Japanese has acquired neither the knowledge of how to cultivate it, nor a taste for it. And, indeed, it is a favourite with very few nations as with us. The potato fills nowhere so prominent a place as in the domestic economy of Teutonic and Slavic peoples. After crossing the northern boundary of the Mediterranean region, we

[1] See also Turpin: "Mémoires du Muséum," vol. xix., pp. 1, ff., and A. de Candolle: "Archives des Sciences phys. et nat., Troisième Période." vol. vii., No. 6, 1882.

perceive a rapid diminution in its cultivation, and one that is caused much less by difference of climate than by a change of taste and the prevalence of substitutes, such as chestnuts and sweet-potatoes. Thus, in Northern Italy it occupies 0·33 per cent. of the area ; in Central Italy, 0·24 per cent, but in Southern Italy, only 0·03 per cent. A similar diminution is seen on the Iberian Peninsula. This, too, explains why the potato was not long ago carried to Japan by the Portuguese. They found it desirable to introduce tobacco, grape-vines, and quinces (from which a favourite sweetmeat is made in Spain and Portugal), but not *Solanum tuberosum*.

Araceæ, so much cultivated on account of their bulbs, do not bloom in the fields any more in Japan than elsewhere, since they can only go through one period of vegetation there, and that does not suffice for them to put forth stalks. So they remain in the low herbal or monopodal form. This renders it rather hard to distinguish them. The most prized and most widespread kind not merely in Japan, indeed, but throughout the whole monsoon-region and Polynesia, is :—

8. *Colocasia antiquorum*, Schott (*Arum esculentum*, L.), which the Japanese call usually simply Imo, or Sato-imo (village-potato). But the South-Sea Islander calls it Taro. Other Japanese names distinguish different sub-species. At the ends of short sprouts (stoles), the axillary buds develop in several directions from the mother-bulb (Oya-imo), which resembles a rhizome. These buds become fleshy white tubers (Ko-imo), in the shape of an ellipsoid or ovate, about the size of a hen's egg and weighing from 60 to 80 grs. Of carbon-hydrates, they show more glucose and dextrine than starch,—hence their peculiar sweetish flavour. Propagation takes place by means of bulbs, as in our potatoes. The petioles of the Sato-imo are green and longer than in most other kinds of the imo belonging to this division; the shield or heart-shaped leaves themselves larger. On the upper side they are a polished green, on the under side, a greyish white.

9. *Leucocasia gigantea*, Schott (*Caladium esculentum*, Sieb.), Jap. Hasu-imo, resembles the foregoing closely, but is nevertheless not so much prized and planted.

10. *Alocasia macrorrhiza*, Schott (*Arum macrorrhizum*, L.; *Colocasia esculentum*, var. C. and Z.), Jap. Manshiu-imo. This kind, likewise widely grown in the South Sea under the name of Taro, and elsewhere too, forms only one large bulbous rhizome.

11. *Conophallus konjak*, Schott (*Arum Dracunculus*, Th.), Jap. Konniyaku (pronounced Konjak), produces a single bulb, like the foregoing kind, only much smaller. It serves in the preparation of a gelatinous, tough food, which bears the name Konniyaku.

Of yams, or *dioscoreæ*, the Japanese use the following :—

12. *Dioscorea japonica*, Thunb. (*D. oppositifolia*, Thunb.), Jap. Yama-imo, that is, wild potato, or Jinén-jô. It is wide-spread in hill and mountain-forests, up to a height of about 600 m. It twines

about through the bushes here, two or three meters high, and around tree-trunks, putting forth in June numberless delicate greenish yellow blossom clusters from the bases of its leaves. Because of its long cylindrical root, it is also called Naga-imo (long potato, a name which, however, is applied chiefly to the cultivated form). Jinén-jô is the favourite of all the varieties of Imo. It roots come to market from 25 to 50 cm. long and weighing 150 to 200 grammes. They bring the highest prices. Under these circumstances, it is remarkable that, like all yams in Japan, it is relatively so little grown. This is the case, too, in China, where it is called Ta-shu (big root). The little plantations found here and there are easily recognised by the short sticks about which the tendrils twine. One variety of Naga-imo, namely *Dioscorea japonica*, var. *bulbifera*, bears the name Kashiu-imo, and also Tsuku-imo, It has round roots resembling potatoes.

13. With regard to this second kind (*D. sativa*, L.), Jap. Tokoro or Naga-dokoro, it seems to me that Savatier is mistaken when he says, "Hab. in Japonia sæpissime culta;" for it is grown but sparsely, as far as I could observe it in various parts of the country.

14. *D. quinqueloba*, Thunb.; Jap., Kikubaba-dokoro, is mentioned by Savatier as growing wild. I know neither this variety nor its use. In the Kew collection there is some starch made from it.

The bulbs of lilies (Yuri), many species of which grow on the Hara (forest-glades) and in wooded districts, are also much sought after for food, like the roots of the wild yams, and particularly by the poorer people and the Ainos of Yezo. The three following are, I think, especially worthy of notice in this connection.

15. *Lilium auratum*, Lindl.; Jap., Horaiji-yuri, which is found in vast numbers on grassy mountain-sides.

16. *L. Thunbergianum*, Roem. and Schult. (*L. nodosum*, Thunb.), Jap. Hirata-yuri and Natsu-sukushi-yuri. Thunberg expressly mentions its edible bulbs. For their sake, this variety is also much grown, according to L. Boehmer, in the vicinity of Hako-date.[1]

17. *Lilium cordifolium*, Thunb.; Jap. Uba-yure and Kawa-yuri. According to Steube, the Ainos make a sort of starch from its bulbs, which is boiled with millet or other grain.[2]

18. Common brake (*Pteris aquilina*, L.), Jap. Warabi. This plant, perhaps the most widespread in the world, is also found in the Japanese islands throughout their whole extent, from Formosa to Kamtschatka. But it is not so little esteemed there, and so useless to man and beast, as it is with us.[3] People begin to gather its young and not yet unrolled tips in April and May, and eat them

[1] "Report to the Kaitakushi," 1875, p. 202.

[2] "Mittheilungen der deutschen Gesellschaft Ostasiens." III. Bd. Yokohama, 1880–84, p. 223.

[3] In Shikoku I saw in 1875 whole stretches of mountain forests burned up in order that Warabi might grow better. (See Rein, "Japan," i. p. 81.)

fresh, in soup or as vegetables, or preserve them dried for the same uses. But in autumn, when the parts above ground die off, the horizontally branching rhizomes are dug up and used for making fern-starch, Warabi-no-ko, *i.e.* brake-fern meal. The mode of procedure is simple, being like that employed in obtaining other sorts of starch. The rhizome or root-stalk is dried, broken, and pulverized, mixed with water, squeezed through coarse hemp-linen bags, to separate the starch from the fibres, and then clarified further, till the meal has reached the requisite purity. In this state it is light-grey in colour, and can be bought anywhere. Mixed with millet, wheat-flour, or rice-flour, it is extensively used in cooking, especially by the poor, in Northern Honshiu, for example, and in Yezo, where millet and brake-fern are the principal food-plants. Warabi-no-ko serves yet another purpose. A glue is made from it, which, mixed with Shibu, the sour juice of unripe Kaki-fruit, withstands rain, and is used for pasting paper together, which is oiled and then used for making waterproof-cloaks and umbrellas, and for defence against rain in other ways.

The brake serves for food, not only in Japan, but also in Corea and other parts of the continent of Asia. And A. von Humboldt asserts of the Canary Islands Palma and Gomera, that their inhabitants pulverize its root-stalks, mixing them with barley-meal, and use it thus for food. It is well known that Australia, at the time of its discovery, possessed only one edible root, the *Pteris esculenta*, a near relative of our common brake.

(d) *Vegetables and Condiments.*

In this group we meet with a great number of most dissimilar plants, partly truly cosmopolitan in household economy, partly peculiarities which have been developed by the land and the special tastes of its inhabitants. This division does not furnish such important articles of food as the farinaceous "cereals, pulse and root crops;" yet not a few of its members play an important part as a daily spice of material life, in so far as it is affected by the enjoyment of a well-flavoured soup, or of rice and its substitutes. One acquainted with Japanese cooking will recall first in this connection the Daikon (giant radish), Nasu (fruits of the egg-plant), Negi-rui (onion family), Uri-rui, (cucumber tribe), Take (mushrooms), and other kitchen-plants, which in this respect seem quite indispensable. Table vegetables among the Japanese are eaten generally in much smaller quantities than with us, and a large number of those most widely scattered and most popular among us are missing altogether, *e.g.*, most of the cabbage-varieties, rape-cole, scorzonera, asparagus, and many salad-plants.

The Japanese distinguish between Yasai-mono or Yasai, vegetables, Tsuke-mono, fruits preserved in salt water or vinegar, so-called pickles, and Yakumi, or relishes proper,—a division which can hardly be sharply carried out, since the same product, according to its preparation and application, appears as a vegetable dish or a relish, as, for example, the onion. I shall not, therefore, enumerate and descant upon these plants in any such grouping, but rather recommend their introduction in a systematic order, as follows.

1. *Brasenia peltata*, Pursch. (*Menyanthes nymphoides*, Thunb.), Jap. Junsai, and

2. *Nuphar japonicum*, D. C. (*Nymphæa lutea*, Thunb.), Jap. Kawa-hone and Ko-hone. The rhizomes and young leaves of these two *Nymphæaceæ* are eaten, and for this purpose are cultivated here and there in small ponds. The leaf-buds of *Nymphæa tetragona*, Georgi, Jap. Hitsuji-gusa, eaten with vinegar, are a favourite dish, especially in Yezo.

3. *Papaver somniferum*, L., Jap. Keshi. Poppy is grown in Japan only to a very limited extent. Its seeds are used as a spice, but not for producing oil.

4. *Eutrema Wasabi*, Maxim. (*Cochlearia Wasabi*, Sieb), Jap. Wasabi, the Jap. horse-radish, which grows wild on the coast, and is grown in small quantities, rasped up and eaten with fish.

5. *Brassica chinensis*, L. (*B. orientalis*, Thunb.), rape, Jap. Na. The young leaves are either eaten as a vegetable or a salad.

6. *B. oleracea*, L., Jap. Botan-na, Kappa-na. Most plants of the cabbage-order have been only lately introduced, and are not yet widely spread. Longer known and more generally cultivated is a green variety of cabbage, not so sour as the corresponding kind in Europe, and very pleasant to the taste.

7. *B. rapa*, L., turnip, Jap. Kabura and Kabu, are raised in many sub-species, and sometimes used as a vegetable, boiled, sometimes as salad. Both roots and leaves are turned to account. The ordinary, flat variety predominates; but there are also long conical sorts, *e.g.* the Akanaga-kabura, *i.e.* red long-turnips. Ômikabura and Ô-kabura are among the thickest kinds.

8. *Sinapis integrifolia*, Wild., Jap. Ô-garashi, Taka-na.

9. *S. cernua*, Thunb., Jap. Karashi-na.

10. *S. chinensis*, L. (*S. japonica*, Thunb.), Jap. Midzu-na, Ise-na. The leaves of these three mustards, like those of rape, are eaten either as salad or vegetables. The use of their seeds as a spice was known to the Dutch, though they were but little propagated. (See Oil-plants.)

11. *Raphanus sativus*, L., Jap. Daikon. Raw, boiled, dried, and, above all, cut up and pickled, the Japanese radish is undoubtedly the most widely known and favoured vegetable with rice. It is relished equally well by the fisherman and hunter of the more distant islands and the polished inhabitants of the capital. Hence special attention is paid to its culture, which extends as far as the Japanese has permanently settled. In the central and

southern parts of the country, it is raised in all seasons of the year, especially in winter, and sometimes yields enormously long, thick roots from 2 to 3 kg. in weight. The Daikon near the bay of Kagoshima are especially noted for their size and quality.

Culture has in the course of time produced sub-species, chiefly with long, cylindrical roots, as Sakura-jima Daikon, Miyashige D., Karahashi D., Murasaki D., Natsu D., Sangatsu D., Hadano D. Some, however, are more like rape-cole or rape, short and thickset, as Kudzu-hata D. and Karami D., and are even found with bundles of roots, like the bamboo-cane and the palm: the Tako (*Poulpe*) or *Octopus* D. Most sorts are white and resemble long turnips. The violet, red, and grey-black are known as Murasaki-, Aka-, and Kuro-Daikon. The European is at first agreeably astonished when he sees the big radishes, washed and tempting-looking, as they are brought to market, especially about spring-time; but, as a rule, he finds their taste and smell when prepared for the table equally disagreeable.

12. *Portulacca oleracea*, L., Jap. Suberi-hiyu, planted in some places, but mostly wild, and little used.

13. *Zanthoxylon piperitum*, D.C. (*Fagaria piperita*, Thunb.), Jap. Sanshô. The young leaves, and still more the peppery seeds, of this widely extended shrub, serve as a condiment. For this purpose, it is often cultivated near peasants' houses. The other kinds of Zanthoxylon, which are wild, are used somewhat in a similar way, but less often.

Passing over the Aurantiaceæ and Pomaceæ, which will be considered under fruits, we come to the Cucurbitaceæ, which are represented in many varieties and forms. These are planted :—

(*a.*) On account of their edible products :—

14. *Cucurbita pepo*, L., the pumpkin, in its typical flat, radiating, ribbed forms. Its Japanese names are Tônasu, Bôbura and Kabocha (*i.e.* Cambodia). The last indicates the source of one favourite species. Another Japanese sub-species has lately been extensively tried in France, under the name of *Cucurbita melonæformis*. They praise its productiveness, the thick, light-yellow flesh and the agreeable taste of its fruit when boiled. Its flavour is something midway between that of the potato and maize. These pumpkins are deeply and regularly furrowed and attain a circumference of 55 cm. and a height of 13 to 16 cm. Their colour varies from copper-red to deep green.

15. *Benincasia certifera*, Savi (*Cucurbitacerifera*, Fischer), the white gourd, Jap. Tôgan and Kamo-uri.

16. *Citrullus edulis*, Spach (*Cucurbita citrullus*, L. and Th.), Jap. Suikuwa (pronounced Suika), the water-melon. This fine fruit develops but little aroma in Japan, so that its taste is far inferior to that which it possesses in the Mediterranean region and other districts with hot, dry summers. I have no knowledge as to the antiquity of its culture in Eastern Asia. In Egypt, as is well known,

the water-melon was grown more than 3,500 years ago, as was proved by the tomb-discoveries of Brugsch and Maspero in 1881.

17. *Cucumis conomon*, Thunb., Jap. Shiro-uri, white melon. One frequently meets with the rather large oval fruit of this species, greenish white in colour. It is commonly pickled and eaten as a vegetable with rice, instead of Daikon.

18. *C. flexuosus*, L., Jap. Awo-uri, green melon.

19. *C. melo*, L., the melon, Jap. Makuwa-uri (*Cucumis melo*, L.). A large, strong-branched variety, some seeds of which were taken to France in 1877, where it has been grown since. Its large, cylindrical, thin-rinded fruit attains a length of 15 cm. and a thickness of 7·9 cm. Its greyish-green flesh is thick, fine, and of a sweet, agreeable flavour, though with little aroma.

20. *Cucumis sativus*, L., the cucumber, Jap. Ki-uri, was, at some time or other, introduced from China.

Besides these, the fruits of the wild-growing *Momordica charantia*, L. are used, under the name of Tsuru-reishi and Niza-uri.

(*b.*) The following species are grown for the sake of the rind or the tissue of their fruits.

21. *Luffa petola*, Ser., Jap. Hechima, Tô-guwa. The long cylindric fruit resembles a long straight cucumber. When ripe, it is yellowish. In the green state it is eaten ; but when ripe the pulp disappears and is replaced by a web of fibres, furnishing the so-called Luffa-sponge.

22. *Lagenaria vulgaris*, Ser. (*Cucurbita largenaria*, L.), Jap. Fukube and Higotan, furnishes in its many-shaped shells cheap, popular vessels for daily use, not only in Japan, but in the whole monsoon-region and in Africa. In other lands these are often called calabashes by Europeans, a name which is also applied to the fruit of the melon-tree (*Crescentia cujete*), whose hard shells are converted into many sorts of vessels, such as buckets, bowls, spoons, etc., by the aborigines of tropical America. The pear-shaped outline of the flask-melon has served in Japan and China as a model, often used for Saké-bottles. So have those which appear to be made of two large balls set one on top of the other. *Lagenaria dasystemon*, Miq., Jap. Kamo-uri, is similarly utilized.

(*c.*) For making starch, the Japanese use, to a modest extent, the seeds of several wild-growing varieties of the species Trichosanthes,—Karasu-uri (*T. cucumeroides*, Ser.) and Ki-karasu-uri (*T. japonica*, Regel).

23. *Apium graveolens*, L., celery. Its Jap. name Oranda-mitsuba, Dutch trefoil, indicates perhaps that it was first introduced into De-shima by the Dutch.

24. *Petroselium sativum*, Hoffm. (*Apium petroselium*, L.), parsley, seems also to have been first introduced by the Dutch.

25. *Pimpinella anisum*, L., Jap. Uikiyo, anise.

26. *Fœniculum vulgare*, Gaertn., Jap. Kurenomo and Uikiyo, fennel.

27. *Pastinaca sativa*, L., Jap. Amerika bôfu, parsnip.

28. *Coriandrum sativum*, L., Jap. Koyendoro, coriander. All the above-mentioned umbelliferous plants are cultivated also as drugs, Their extent and significance for the Japanese kitchen are slight.

29. *Daucus carota*, L., Jap. Ninjin (not to be confounded with the like-sounding word for ginseng). The carrot, too, is one of the commonest vegetables in Japan. But its cultivation and use are by no means as extensive as with us.

30. *Aralia cordata*, Thunb. (*A. edulis*, S. and Z.), Jap. Udo, a bush, about one meter high, which is found scattered over mountains, and particularly on grassy slopes (Hara), blossoming in July. It is also occasionally planted in the vicinity of dwellings. Its roots, and its young stalks too, are eaten as a vegetable dish and in soup, and people are very fond of them.

31. *Petasites japonicus*, Miq. (*Tussilago Petasites*, Thunb.), Jap. Fuki, grows wild under hedges, along roads and forest borders, but is also cultivated. It blossoms in February and March. The stalks of its leaves are eaten with vegetables.

32. *Lappa major*, Gaertn. (*Arctium lappa*, Thunb.), Jap. Gobô. The common burdock exists in Japan just as with us, but has a use of which we know nothing. Its long, fleshy tap-roots, as thick as one's thumb, and with an average weight of 350 grs. are eaten by the common people. Like the roots and bulbs of some other composites, they contain inuline.

33. *Cichorium endivia*, L., Jap. Kiku-jisa and Oranda-jisa.

34. *Lactuca sativa*, L., Jap. Chisa, lettuce. Both of these are cultivated and made into salad and other articles of food, but to a much smailer extent than with us. Especially to the country population they are almost altogether unknown. It is evident, too, that they were first introduced by the Dutch.

35. *Solanum melongena*, L. (*S. esculentum*, Dunal), Jap. Nasu or Nasubi, the egg-plant, l'Aubergine in French. From June or July, when its large violet blossoms appear, followed generally by a wealth of beautiful similarly coloured fruit, this plant is a real ornament of the dry Japanese fields. It is grown all over the country and extends from there over the warmer lands of Asia, quite to the Mediterranean-region.[1] But the egg-plant is raised in several countries of Africa and also in America. The Japanese cut up the oval, club-shaped or pear-shaped fruit, boil the pieces in soup or put them in brine and eat them as a salad with rice, instead of radishes. In other countries, *e.g.* India, France, North America, the fruit is cut through lengthwise, fried in butter, and eaten, all but the outer rind, as a vegetable. An attenuated form appears in the markets of Paris under the name l'aubergine

[1] In "Frau Baron von Gerstorf's Reise in Syrien von Aleppo nach el Deir am Euphrat." Peterm. Mitth., 1865, p. 53, we read, for instance: "Wir kauften noch einige Wassermelonen und Patlitdschan (*Solanum melongena*, L.), denn hier waren ganze Felder damit bebaut."

violette, which in shape resembles our kidney-potato. This sub-species is met with in Japan, too, but another, with large violet fruit, pear or club-shaped, is probably the most widespread. They are all on the same level as to percentage of water contained and value as food, resmbling watery pumpkins, but requiring great summer-heat, which the German climate cannot supply.

36. *Lycopersicum esculentum*, Mill., Jap. Aka-nasu, To-nasu, the tomato or love-apple, is also found in Japan, but has, compared with the egg-plant, only a slight importance in domestic economy there.

37. *Physalis Alkekengi*, L., Jap. Hôdzuki, "bladder-cherry."

38. *P. angulata*, L. (*P. ciliata*, S. and Z.), Jap. Sennari-hôdzuki. This sort, as compared with the common winter-cherry, is of infrequent occurrence. Siebold says of the latter: "Fructus edulis ac pro nugis habetur venalis." The skin of the berry is a favourite and unique toy of Japanese girls, especially when carrying their younger brothers and sisters on their backs. They separate the red fruit, which is of the size of a small cherry, from the orange-coloured skin enclosing it, and preserve the berry in salt-water. By rolling and pressing, they free the skin from the flesh and seeds within, squeezing them out through a little hole opposite the stem-end. The skin of the berry has now two openings, like a lamp-globe. This they put in their mouths, blow it full of air, and then compress it between their gums, making a peculiar noise. Herein consists all the fun.

39. *Capsicum annuum*, L., Jap. Tôgarashi, Chilies, Spanish or Cayenne pepper, Span, *pimiento*, Fr. *piment*. It is cultivated in many sub-species, which are distinguished principally in colour, form, and size of their fruit. Thus in Japan the Naga-tôgarashi is especially frequent,—long, pointed peppers (*C. longum*, D.C.) with glittering red or black berries; also the Maru-tôgarashi, with heart-shaped berries (*C. cordifolium*, Mill.). The black varieties are called Murasaki-tôgarashi; the red, Aka-tôgarashi.

40. *C. frutescens*, Willd., likewise called Tôgarashi, occurs much seldomer in Japan than the above-mentioned herb-shaped kind.

According to De Candolle,[1] the Spanish pepper originated probably in tropical America, whence, at any rate, it rapidly spread, soon after Columbus's discovery, for it was known in England as early as 1548. A warm climate is necessary to its proper development. In many lands it is the favourite spice, either fresh, pickled, or pulverized. Captain Hall remarks,[2] "Chilies (*i.e.* Spanish pepper) form the chief condiment of Corean cooking," and notices further that they are missing in scarcely any dish, and are much grown in the vicinity of villages.

The word Tôgarashi, pepper, is also used in Japan as a generic name for several different spices. Thus, every morning during my first stay of five months in the German legation at Tôkio, I

[1] "L'origine des plantes cultivées." Paris, 1883.
[2] Captain Hall: "A visit to Korea." *Proc. R. G. S.*, 1881.

heard a woman, in passing my windows, cry: "Nana iro tôgarashi!" *i.e.* literally, "seven sorts of Cayenne pepper." She sold a pulverized mixture of seven spices, Tôgarashi being the chief component. The other ingredients were: 2. Chimpi, dried orange peel, 3. Goma, sesame-seed; 4. Koshô, black pepper; 5. Sanshô, *Zanthoxylum piperitum*, D. C.; 6. Keshi, poppy-seed; 7. Asa-no-mi, hempseed.

41. *Perilla arguta*, Benth. (*Ocymum crispum*, Thunb.), Jap. Shisô. There is a distinction between Aka-shisô, with purple-red leaves, and Ao-shisô, with green. Shisô is a very general kitchen-plant. Its young leaves are eaten as a vegetable and in soup. By soaking the leaves of the red variety in plum-vinegar, their colouring matter is extracted, and the resulting red fluid is used in preserving and colouring lumps of ginger and various other roots and fruits.

42. *Beta vulgaris*, L., Jap. Tensei, beet. Not general.

43. *Spinacea inermis*, Moench. (*S. oleracea β*, L.), Jap. Hôrensô. Spinach is eaten as a vegetable as with us, though not to so great an extent.

44. *Polygonum orientale*, L., Jap. Ô-tade, the oriental knotgrass. This variety, which probably is traceable to India, and is known over a considerable part of the Old World, was, according to Thunberg, first introduced into Japan by the Portuguese. It is found planted here and there, as with us, though not as an ornament, but on account of its leaves. The same purpose is served by *P. japonicum*, Meissn. (*P. barbatum*, L.), the Tade or Bontoku-tade.

45. *Rheum palmatum*, L., and *Rh. undulatum*, L., Jap. Daiō. Rhubarb is grown for medicinal purposes mostly; but its stalks are now and then utilized in the kitchen, as with us.

46. *Cinnamomum zeylanicum*, Breyn., and *C. Loureirii*, Nees, Nikkei, cinnamon or cassia-trees of Japan. The former is cultivated only here and there; the latter more frequently. The rind, of little value, obtained from the latter is exported via Nagaski, to a modest extent.

47. *Cannabis sativa*, L., Jap. Asa, hemp. The utilization of its grated seeds as a condiment was mentioned above under Spanish pepper. In regard to the much more important question, as to its bast, particulars are given under textile-plants.

48. *Zingiber officinale*, L., Jap. Shôga. Ginger has been cultivated on account of the "claws" of its rhizomes, for home consumption, from time immemorial, and always on small damp bits of ground, near dwelling houses, as in China. One may, however, go through many a village without seeing any of it. Ginger was taken to Kew by Sir Joseph Banks, in 1796. Its rhizomes are usually preserved in reddened plum-vinegar, and make a much relished though not common flavouring with rice, instead of Daikon. The young shoots or roots of ginger often appear as a condiment with a certain dish of fish, called Ni-zakana (boiled fish).

49. *Z. Mioga*, Roscoe (*Amomium Mioga*, Thunb.), Jap. Miôga. Less cultivated than the common ginger. Yields a condiment in its young shoots.

47. *Curcuma longa* L., Jap. Ukon, is to a limited extent likewise cultivated as a condiment, while the well-known yellow dye-stuff is imported from China and India.

Condiments of the leek order, "Shin," *i.e.* stinking herbs, as the Buddhist priest of East Asia calls them, have hitherto existed among all civilized nations, though they have not acquired the same importance everywhere. While, for example, the Spaniard scarcely eats meat of any kind without its being seasoned with garlic, and the Russian regards an onion together with its green top as a tit-bit, such a decided liking is only occasionally found among the Germanic peoples. The fondness of the Israelites for onions and garlic is well known, and is as old as their history. The onion is with many races not a mere relish only, but a real food. To comprehend this, one must remember that besides our common sorts—sharp and tear-compelling—there are others, like the red Portuguese, which often weigh a kilogramme, especially in warm, light soil, and have an agreeable sweetish taste, so that when cooked they can take the place of other vegetables.

The Japanese call the cultivated varieties of leek after the onion —Negi-rui, *i.e.* onion group. Five of them, the Go-shin, *i.e.*, five pungent, stinking herbs, seem to have been especially popular within the range of Buddhism. The enjoyment of them was, and is, strictly forbidden to priests, with the exception of one sect. An inscription at the entrance to many of their temples and cloisters, usually carved on an obelisk of stone, reads, translated: "It is forbidden to carry stinking herbs and intoxicating drinks through this holy gate."

Among the chief accusations brought by Nobunaga, against the monks of the Hiyei-san,[1] is, that they ate fish and stinking herbs, therein despising the law.

The following comprise the Go-shin:

51. *Allium sativum*, L., Jap. Ninniku, garlic, a plant long used by man, well known to the old Egyptians and Greeks, and grown in Japan since the beginning of its history. According to Regel, garlic is indigenous on the Kirgis steppes and Tsungarei.

52. *Allium cepa*, L., Jap. Negi, the onion. It is found wild in the outlying spurs of the Iranian plateau, and also southward from Kuldscha (Regel). In Japan its planting occurs usually in February or March, its harvest in autumn.

53. The winter-onion, Jap. Negi (*Allium fistulosum*, L.), which originated in the Altai Mountains, like the foregoing, is raised in several varieties. The Japanese eat onions either boiled or fresh, cut into pieces, as a condiment.

[1] See Rein, "Japan," vol. i.

54. *Allium ascalonicum*, L., Jap. Wakegi, the shalot. This is not known in a wild state, and is considered by de Candolle merely a sub-species of the onion.

55. *Allium schœnoprasum*, L., Jap. Azatuki, the chives, also much grown endemically, though not in Japan.

56. *Allium porrum*, L., Jap. Nira, leek or porret, is, according to Gay,[1] a cultivated form of *A. ampeloprasum*, L. According to Kinch, *A. senescens*, L., is designated Nira. The onion and stalk of this especially pungent variety are eaten mostly boiled.[2]

Besides the above-mentioned kinds of leek, the following also are used in Japan :

57. *Allium splendens*, Willd. (*A. arenarium*, Thunb.), Jap. Rak'kiyo and

58. *A. japonicum*, Regel, Jap. Yama-Rak'kiyo, two species, of which I do not know the cultivated forms.

59. *Bambusa puberula*, Miq., and several other kinds of Take or bamboo-cane furnish the kitchen with Take-no-ko, young bamboo-sprouts, which break forth from the ground in spring like giant asparagus, and yield at this season a much relished, but insipid dish.

60. *Pteris aquilina*, L., Jap. Warabi, brake-fern. The rhizome of this plant, as a yielder of starch, was noticed in a former section. But its young tops, too, as long as they are yet undeveloped and rolled together, are highly esteemed throughout the Japanese Empire, and much eaten in soup.

In addition to the vascular plants mentioned in the foregoing list, and a large number of other, mostly endemic varieties, which are now and then utilized in Japanese kitchens as vegetables or relishes, we must here consider the fungi and marine algæ. Numbers of people are employed in gathering, preparing and disposing of these plants, which are useful not only for home consumption but also in commerce. Unfortunately the fungi, as well as the lichens of the land, have been hitherto very hardly treated by the botanists. Von Siebold certainly offers us a list of 32 Japanese names, "quæ vero fungorum species, aut sponte crescentes, aut arte imo provocatæ, crudæ, salsæ, siccatæque vix in ulla desunt coena"; but there is no closer description or discrimination of them. This gap exists still, nor will it be filled up by the following remarks. They may serve, however, at least to dispose of some

[1] "Ann. des sc. nat." 3e série. Vol. 8.

[2] With the above mentioned chief Japanese varieties of leek, I was able to reconcile, only in part, an older list of the Go-shin, for which I am indebted to my learned friend, the priest Nanjio Bunyiu. It follows here with its Chinese-Japanese and Japanese names, the latter in parenthesis : Dai-san, (Chobiru), Shio-san (Ninniku), Kôkyo (Aratsuki), Ji-sô (Hitomoji or Negi), Kaku-sô (Nobiru). The least is *All. nipponicum* F. and Sav., a variety which, so far as I know, is not cultivated at all.

errors, and to establish scientifically several varieties with which I became more intimately acquainted.

The Japanese designate by Kinoko and Kusabira, the larger fungi in general, and by Take, as affix to the proper name, in particular cases. Several varieties of Agaricus stand first in their estimation, namely Shii-take and Matzu-take.

57. *Agaricus Sp.*, Jap. Shii-take. This is an agaric, without ring and anil, the hood eccentrically placed and irregular, having a brown outer skin and white lamellæ. The stalk likewise is white, rather high and moderately thick. Shii-take has therefore only a slight resemblance to our common champignon (*A. campestris*, Pers.), being closer in appearance to *A. fusipes*, Fr., *A. contortus*, Berk. and *A. attenuatus*, D. C. It is the more incomprehensible how often they have been confused with it, from Kaempfer's and Thunberg's time down to the present day. Thus Kinch in his list adduces Shii-take as Agaricus campestris, and we find in the catalogue of the Japanese section of the International Health Exhibition, London, 1884,[1] an analysis of it under this name. According to it, the mushroom when dried, contains 11·847 per cent. of albumen, 1·685 per cent of fat, 67·508 per cent of cellulous, and other nitrogenous components, 4·370 per cent. of ashes, and 11·490 per cent. of water.

The Shii-take is easily dried and preserved. In this process there is developed and retained an excellent aroma, which makes it the most precious and valuable of all Japanese fungi. It derives its name from the Shii-tree, an evergreen oak (*Quercus cuspidata*, Thunb.) of Central and Southern Japan. But the quantity of it found on rotting roots and stumps is by no means equal to the demand. This is mostly met by artificial propagation, as in the case of truffles and champignons in Europe, which in my opinion it far excels in flavour. Truffles and champignons are used for sauce chiefly, and so Shii-take serves principally in making savoury soups. If the quantity used at home and exported (to China) does not represent such great sums as those, the plant is, nevertheless a factor worth mentioning.

Its artificial production, which is described more thoroughly in the English consular report from Kanagawa (Yokohama) for 1875,[2] is subserved not only by Shii-noki (*Quercus cuspidata*, Thunb.), but also by other oaks, as Kashi (*Quercus acuta*, Thunb.), Kashiwa (*Q. dentata*, Thunb.). This takes place chiefly in the bark of felled trees, and is carried on in many provinces, namely in Yamato, Ise, Mikawa, Tôtômi, Suruga, Kai, Idzu, Mutzu, Dewa and elsewhere.

58. *Agaricus Sp.*, Matsu-dahi, *i.e.*, pine-fungus, because growing mostly in pine-woods. When fresh, it tastes very good, and is

[1] "Japan. Internat. Health Exhib., London, 1884. A Descriptive Catalogue of the Exhibits, etc., by K. Nagai and J. Murai."

[2] The *Revue Horticole*, of the year 1879, also gives a description of it.

a great favourite. It is eaten in great quantities, either boiled or roasted, and also pickled and dried; but soon loses its savour and becomes insipid.

59. *Cantharellus cibarius*, Fries., Jap. Shiba-take. Under that name persons were offering for sale by the basketful our well-known egg-mushroom, in September, 1874, in the villages at the foot of Fuji-san. I saw it in other places, too, but cannot find it anywhere mentioned as growing in Japan.

60. *Clavaria flava*, Pers., and *Cl. Botrytis*, Pers., Jap. Nedzumi-take, occurs, like the preceding, in the forests of Fuji-san, and is sold in the neighbouring villages.

61. *Lycoperdon Tuber*, L. (Thunb., "Flor. jap." 349). Under the name Shô-ro (Sho for Matsu, pine; and ro-tsuyu, dew), there comes in spring a little mushroom similar to the *bovista*, growing chiefly in pine-woods. It is much eaten in soup and also as a vegetable dish, and although very tender, is almost flavourless. This also is preserved.

The following edible fungi are also frequently mentioned: Shimeshi, Kikurage, Tsuga-take, Hatsu-take, Hira-take, and several others, with which, however, I am still unacquainted.

In connection with the preceding, let me here mention two other dry fungi, which, though of no account as food, should not pass unnoticed, being widely spread and utilized in a remarkable manner.

In Thunberg's "Flora japonica," p. 347, a tree-fungus is spoken of under the name of *Boletus versicolor*, which we must add to the dry Polyporus varieties. It bears, as Thunberg too remarks, the name Saru-no-koshi-kake, *i.e.* ape-stool, and seems to be distributed all over the land. It clings to the trunks of old foliaceous trees in mountain-forests, often attaining great dimensions. I have in my possession one 40 cm. broad and about 20 cm. long. In Nikko people make plates out of them, the borders of which show two or three growth-rings of the mushroom with all the natural irregularities. Below they are sawed off and varnished in black; their upper part is hollowed out and varnished red, and they thus make unique and very pretty vessels.

The second kind of fungus, still more widely known, bears the name Reishi, and is a dry, hard, and really worthless sort of hood-mushroom, in appearance related to the *Polyporus lucidus*, Fries. or *P. amboinensis* of Farther India and the Malay Archipelago. Reishi is the size of our champignon (*A. campestris*), and has a stalk which grows occasionally 15 cm. long, and is dark brown like the hood. If it perchance grows to be a curiosity on the stem of an old dwarf-tree in a gardener's pot or tub, the tree is straightway taxed from one to two yen (4 to 8 shillings) higher, and looked upon as a sign of luck, Medetai, and an occasion for congratulation. Reishi counts, too, as a good omen in general, and is used to decorate the Tokonoma or slightly raised projection of a room.

The sea-weeds[1] are of far greater importance than the mushrooms for Japan. Nowhere else do they form a part of the people's diet to such an extent as with the nations on the Pacific side of Asia. Not only the giants of the marine flora are taken up by the Chinese and Japanese and utilized in various ways as food, but also the more delicate red and green sorts, the use of which has been adopted by the Malays also. In Europe the consumption of a few varieties, as *Alaria esculenta*, Grev., *Sphærococcus palmatus*, K., *Porphyra laciniata*, *Gracilaria lichenoides*, A., and some others, is limited to the poor sea-coast population of the north, especially of Ireland, Scotland, Iceland, and Norway; while the Frenchman, for example, generally not at all particular in the choice of marine animals for food, and able with his culinary art to make every sort appetizing, despises the algæ.

The marine flora is influenced most by light and temperature, and hence by the depth, situation and form of bays, and by ocean currents. Sea-water does not change its temperature as readily or as often as the air. It is the medium of distributing its own inhabitants, and touches all parts of the world. Moreover, the fish and turtles which feed on algæ swim with its streams over vast areas, and carry seeds to distant shores. From all these causes, it is inevitable that many algæ should be widely distributed, and that we should find many a variety in the waters of Japan which are known in other parts of the ocean, too. The circumpolar tangle (*Laminariæ*) and seawracks (*Fucus* species) prefer cold sea-water and a heavy surf, both of which are to be had in the vicinity of the island of Yezo and the Kuriles. Two other groups of the *Melanosperms*, the *Cystosiriæ* (bladder-string seaweed) and *Sargassaciæ* (berry-seaweed) join them in the south. The last-named family is represented in especial profusion in several groups (*Sargassum*, *Spongocarpus*, *Halochloa*, *Myagropsis*, *Coccophora*). I never saw them used in housekeeping, but only as manure, except *Halochloa macrantha*, Kg., Jap. Houdawara, which is eaten with vinegar, and pickled. A considerable amount of light is the chief condition of life for the more delicate green sea-algæ. Many of them do not require very salt water, and are found at the mouths of rivers and in pools where there is little salt, and also on the coast above the mean tide level.

[1] An exhaustive work on this subject does not yet exist. Thus far the following have noticed Japanese varieties :—

1. Kützing, in his well-known work, "Species Algarum, 1849, collected by Tilesius, chiefly in Nagasaki."

2. Harvey: "Characters of New Algæ, chiefly of Japan, collected by Ch. Wright. Proc. Am. Ac. of Arts and Sc." Boston, 1857. Vol. iv. p. 327. 54 varieties.

3. G. von Martens: "Die Preuss. Exped. nach Ost-Asien. Botan. Theil. Die Tange.," 1866. 111 varieties, collected by E. von Martens.

4. Suringar: "Algæ Japonicæ Musei Botanici Lugdano-Batavi." Haarlem, 1874. 34 species, collected chiefly by Siebold in Nagasaki.

The red algæ (Floridæ or Rhodosperms), on the contrary, attain the maximum of their growth in deeper water and in places where they are not much influenced by direct sunlight. Those of their varieties which do not follow this rule, but grow near the rim of the sea's great mirror, or, it may be, lie at times partly dry, lose much of their wealth of colour, and incline toward violet, orange, or green.

On the island of Yezo, sea-algæ, particularly the big seaweeds, form, next to fish, the principal article of export, especially to China. The chief elements of this trade in algæ are:—

1. Kombu, the tangle or sea-girdle, *Laminaria sacharina*, Lamour (*L. japonica*, Arech.; *Fucus saccharinus*, Thunb.).

2. Arame, *Capea elongata*, Ag.

3. Katsumi, *Capea flabelliformis*, Rich.

4. Wakame, Badderlocks, *Alaria esculenta*, Grev.; *β. pinnatifida*, Harv.

5. Haba-nori, *Phylittis debilis* Kg., varieties which in part are still gathered on the shores of Honshiu.

Most of the edible green and red algæ bear the generic name Nori, while the words Umi-kusa or Kai-sô are used for algæ in general, these words being simply translations of the English "sea-weed."

Of green algæ several varieties of *Ulvaceæ*, or green laver, are gathered and used on the Japanese coasts, sometimes fresh, in soup, sometimes dried or with vinegar or pickled in salt. These are not merely the cosmopolitan sea-lettuce, or lettuce laver, as *U. Lactua*, L., Ao-nori, and others, but also *Phycoseris australis*, Kg. (*Ulva latissima*, Ag.), called Nori; likewise *Enteromorpha compressa*, Grev. (*U. compressa*, L.). The Japanese call them Ao-nori and eat them either fresh in soup, or dried, with vinegar and starch. They usually appear in commerce in the form of little packages with the thalli running parallel.

Modzuku is the name of the *Mesogloia decipiens*, Sur., which comes especially from the peninsula Kadzusa-Awa, and is used like the above. The same is true of Somen-nori, *i.e.* the vermicelli-algæ (*Nemalion vermiculare*). Several varieties of *Codium*, Jap. Miru, distributed through nearly all the seas, are not lacking either; for instance, *Codium tomentosum*, Ag., and *C. elongatum*, Ag.

The cartilaginous Florideæ, particularly species and varieties of the Gigartineæ, Caulacantheæ, Gelide, Sphærococceæ, and Tylocarpeæ, are distinguished for their high proportion of pararabin, and furnish, with boiling water, algæ-jelly. They are gathered in great quantities on all the coasts of the Malay Archipelago and the waters of China and Japan, and are utilized in part direct as food, partly in the preparation of algæ-glue, Jap. Fu-nori, or algæ-jelly, Jap. Kanten. In trade, these articles, both when raw and dried and when further prepared, are designated by the Malay word Agar-Agar, *i.e.* vegetable. This name was originally applied to *Gigartina* (*Eucheuma*) *isiformis*, *G. spinosa*, and *G. tenax*, which is collected near Singapore, for example, in great masses, and shipped to China. The Chinese use them not only for food, but make of them Hai-Thao, a transparent glue, with which they stiffen silk and other stuffs, and also fill up the interstices of coarse cloths for the manufacture of lanterns. Of the Japanese algæ in this group, the following deserve special mention :—

1. *Chondrus punctatus*, Sur.
2. *Gigartinia tenella*, Harvey, Jap. Ogo.
3. *G. intermedia*, Sur.
4. *Gleopeltis tenax*, Kg. (*Sphærococcus tenax*, Ag.).
5. *Gl. capillaris*, Sur., Jap. Shiraga-nori.
6. *Gl. coliformis*, Harv., Jap. Kek'kai.
7. *Gl. intricata*, Sur., Jap. Fu-nori.
8. *Gelidium corneum*, Lamouroux, Jap. Tokoroten-gusa.
9. *G. Amansii*, Lamour.
10. *G. cartilagineum*, Gail.
11. *G. rigens*, Grev., Jap. Tosaka-nori, *i.e.* cock's-comb algæ.
12. *Sphærococcus confervoides*, Ag., Jap. Shiramo.
13. *Gymnogongrous flabelliformis*, Harv., Jap. Home-nori.
14. *G. japonicus*, Sur., Jap. Tsuno-mata.
15. *Kallymenia dentata*, Jap. Tosaka-nori.
16. *Porphyra vulgaris*, Ag., Jap. Asakusa-nori.

(e) *Fruits, Berries, and Nuts.*

Japan, like China, possesses many kinds of fruit and other edible plants, not only peculiar sorts, but also those which have long been distributed over a great part of the temperate zone. But most of them lack flavour, being insipid and in our judgment not to be recommended. Almost all our favourite fruits, such as apples, pears, cherries, plums, apricots, peaches, soon lose their aroma, and degenerate somewhat in form and size too, when transplanted to Japan or China. Hence Californian apples, for example, win great favour and have a large sale among foreigners, during the winter months, in all the larger ports of Eastern Asia, from Yokohama to Singapore. The cause of this degeneracy of fruit in Japan and China, especially the loss of aroma, may possibly be the climate, particularly in the damp, rainy summers, but this has not yet been definitely ascertained And the land is ill provided with berries, too. Our black mulberries, currants, gooseberries, raspberries, bilberries, and other kinds do not exist there at all, and strawberries and grapes only scantily and in poor quality. The wild berries that are eaten are mostly unpleasant to our taste. Tropical berry-fruits do not enter into the question, as the most important and hardiest of them, the banana, does not come to maturity, even in Satsuma.

It is worthy of note that dwarf training, so popular in Japan with decorative plants, is seldom applied to fruit-trees. The same is true of pyramidal, cordon, and wall-fruit training which are so much esteemed and so widely known in Europe. A few kinds of fruit do receive special attention, however, such as grapes, oranges, peaches, and pears, but even with these such care is not universal. It may be that this results from a national peculiarity of taste, for that of many races differs from ours even in respect to mere material things. For instance, a number of fruits, such as apples and pears, are eaten in Japan, as well as in Morocco and China, while still hard and green, or at least gathered thus and put away to ripen, as the Biwa (*Eriobotrya japonica*). Quite in accordance with this liking, the Japanese value their handsome and juicy though hard and unaromatic pears, which De Candolle[1] rightly calls "*plus beau que bon*," and which most foreigners cannot endure.

Among the few well-flavoured fruits of Japan come first of all mandarin oranges, persimons and chestnuts, to which Eastern Asia is an ancient home. Mandarin oranges were long ago transplanted to Southern Europe and elsewhere from their oldest home in China, but Kaki has been only lately introduced. The chestnut is so widely distributed and so easily becomes wild, that it is very difficult, if not impossible, to determine its original starting-point. A fourth kind of fruit, however, from Eastern Asia, the Eriobotrya japonica, has attained with astonishing rapidity to successful cultivation in almost all tropical and sub-tropical climates inhabited by Europeans. The explanation of this is easily to be found in the character of the plant.

The following enumeration and description of edible Japanese fruits is based upon W. Lauche's practical classification in his "Handbuch des Obstbaues." Omitting the plants of agriculture proper, the Cucurbitaceæ, for instance, which have been already considered, we divide them into kernel and stone fruit, berries, and nuts.

(*a*) Kernel-fruit.

1. *Pyrus sinensis*, Lindl. (*P. usuriensis*, Maxim.), the pears, Jap. Nashi. This tree originated in Mantchooria and Mongolia. It was evidently distributed early over China, Corea, and Japan, where, next to Kaki, it yields the commonest fruit.[2] This variety is distinguished from our common pear-tree chiefly by its leaves and fruit. The former are large and always sharply dentated. The Japanese pears, like our cherries and many apples, are spherical and somewhat flattened at both ends. They are all large, with thick, bronze-yellow skins, which are covered with little light-grey

[1] "L'origine des plantes cultivées." Paris, 1883, p. 136.

[2] Décaisne in his "Jardin fruitier du Muséum Poitiers," pl. 5, gives a good illustration of it; and the *Revue Horticole*, a few years ago, furnished another equally good.

spots. They do not differ so much among themselves as our pears in regard to season, size, shape, colour, or flavour. The early pears, which ripen in August, are, I think, smaller than those of the general crop, which follow one or two months later, but in other respects they do not differ essentially from them. The flesh is coarse, full of lumps, of a yellow colour, very juicy and tolerably sweet, but lacks the mellowness and aroma of our pears. The taste resembles that of ours when green. In addition to the judgment of De Candolle, cited above, there is another in the *Revue Horticole*, which deliberately says that Japanese pears are poor fruit.

The plant is as a rule propagated through shoots, though sometimes through seeds and subsequent grafting. Between the middle and the end of March, stout, healthy yearling shoots, 42 to 45 cm. long, are whittled to a point, and the ends are then charred over a slow fire. The shoots thus prepared are set out one after another in furrows, in good soil, manured with compost, and then packed around with earth. Transplanting takes place a few years later.

Pear-trees are most frequently met singly in Japan, as with us, growing high with natural development, and evidently without special attention. In northern Honshiu the mistletoe (*Viscum album*, L.) often finds lodgment upon them, though more frequently still on Castanea vulgaris Lamk., and also on deciduous oaks. This mistletoe differs from ours in its wine-coloured berries.

Quite another method of treatment and much greater care is employed with pear-trees here and there in the neighbourhood of large cities, *e.g.*, at Kawasaki, between Tôkio and Yokohama. The trees here are planted in rows at equal intervals of twelve Shaku (3·64 metres) in all directions. They are manured twice a year. For this purpose circular rings are dug about the trunks. These are closed again after being filled with manure. Then, too, the ground is kept clear of weeds and loosened from time to time. At a height of five or six Shaku (150 to 180 cm.), the tree-tops are bent horizontally, after the manner of our arbours. Rows of posts, as well as cross-bars of bamboo cane, serve as supports to the branches.

When I inspected these plantations more closely, about the end ef April, blossoming-time was over, and I found the owners busy cutting away the new shoots, 20 to 25 cm. long, lest they should withdraw nourishment from the abundant young fruit. I learned on this occasion that such an orchard has to be renewed every fifty or sixty years. The pears ripen here at the end of August, becoming very large and a beautiful yellow-brown, running into grey-brown. They appear to keep for a very long time, but are just as watery in flavour and deficient in aroma as the others.

2. *Pyrus malus*, L., the apple-tree. This tree and its insignificant fruit, Jap. Ringô, are so infrequent that many a foreigner dwells in the country for years without seeing them.

3. *Pyrus Cydonia*, L. (*Cydonia vulgaris*, Pers.). The quince, Jap. Marumero, was introduced by the Portuguese, and is found scattered all over Japan, planted about houses, though not frequent.

4. *Cydonia sinensis*, Thouin (*Pyrus chinensis*, Poir.). The Chinese quince, Jap. Kuwarin, is likewise grown here and there. Its fruit is smaller than that of the former variety, and is made into preserve. The product of *P. japonica*, Thunb., a nearly related native sort, is scarcely used at all and cannot be looked upon as fruit.

5. *Eriobotrya japonica*, Lindl. (*Mespilus japonica*, Thunb., *Photinia japonica*, Fr. and Sav.). The Japanese name for the plant and its product is Biwa, Chin. Lu-kuh, Engl. Loquat, French Bibasier, Nèfles du Japon, Span. Nispero de Japon. In Japan, China, and Corea, this peculiar, beautiful variety of fruit is esteemed as the first crop of the new year and has been cultivated from early times, though not extensively. I have, for example, only seen scattered trees near peasants' dwellings in Japan, and never large orchards.[1] In the more central parts of Japan the fruit does not mature before June; as a rule, however, it is plucked by the bushelful before that time and put away (with some of the leaves, to the detriment of its flavour), to get ripe afterwards.

The fact that Kaempfer in his day mentions the presence of the Loquat in Java leads to the conclusion that long ago it was spread all over Eastern Asia. In 1787 Sir Joseph Banks brought it to England. Since then it has been introduced into almost all warm countries, *e.g.*, most of the English colonies, the whole Mediterranean region, and the West Indies, for it recommends itself, equally for ornament and fruit, and also for its easy cultivation and quick growth.

It is a tall bush or small tree, making a pleasing and stately appearance with its large leaved evergreen foliage and still more so when covered with white bunches of blossoms or a wealth of yellow fruit. It begins to bear in the third year, producing abundantly between the sixth and tenth; flourishes in a light soil, and has withstood —9° C. of cold on the Riviera and by the lakes of Northern Italy, when many native fruit-trees perished. It is easily propagated, by means of cuttings or seeds. In the Bermudas, whither the Biwa was brought from Malta forty-five years ago, I found ripe fruit on March 3rd, in Malaga on April 7th, in Gibraltar on April 14th. But May and the beginning of June are the proper season of maturity in most Mediterranean countries, as for example, in Seville, where long rows of large fine bushes can be seen in the garden of the Duke of Montpensier. Not only in

[1] It also seems to me very doubtful whether Eriobotrya was derived from Japan and not rather transplanted thither from China in very early times, and then allowed to go wild in different localities, although the authors of works on Japanese flora, from Kaempfer and Thunberg on, call it indigenous. I myself have never found it except under cultivation.

the Mediterranean region, but in the West Indies too, I have found that the Biwa becomes larger, handsomer, and better flavoured than in their Japanese home. The shape, too, has changed. In Japan the fruit is usually more or less spherical and as large as big heart-cherries, in the adopted countries mentioned it is often found in the form of a club or pear. The flesh, which is furnished with a yellow epidermis, lies loosely about 1 to 6 large kernels ; it is very juicy and of a tart, refreshing flavour, but without much aroma, When not fully ripe, however, it tastes sour, and when kept too long, insipid. The Biwa forms a transition to the group—

(*b*) Stone-fruit.

6. *Amygdalus persica*, L., Jap. Momo or Tô. Peaches are by far the most popular and widely-distributed stone-fruit of Japan. They are of Chinese origin, and indeed de Candolle considers China to have been in general the home of this plant. Several varieties are found. They are smaller than the Chinese peaches and most of ours, being, moreover, much inferior to the latter in taste. Many large orchards exist, where they are carefully cultivated. Light sandy soil is chosen, as in the Mediterranean region and the United States. The trees are planted in rows and are trimmed to medium height. The ground is kept free from weeds.

7. *Prunus armeniaca*, L., Jap. Andzu, apricots of the small-fruit kind found in Southern Europe, and seen often in Germany also, and called by Duhamel " abricot de Portugal." They are here and there offered for sale in July, but in general are rare. I found them to be not materially different from ours in appearance and taste.

8. *Prunus insititia*, L., and *P. domestica*, L. Real damsons, as well as cherries, are not found in Japan. Of the many sub-species of plums one meets now and then a few the fruit of which looks good enough, but it tastes insipid and watery. They have evidently, like the apricots, found no great favour, and were probably introduced some time ago by the Portuguese or Dutch. The name Hadankiô is applied to a big yellow egg-plum, which recalls Dame-Aubert (Duhamel). Botankiô is a red variety, possibly identical with *Prunus oxycarpa*, (Bechstein). There is also a kind resembling the Victoria plum.

9. But the common red plum of Japan, called Su-momo, is *Prunus japonicus*, Thunb.

10. *Prunus Mume*, S. and Z. (*Amygdalus nana*, Thunb.), Jap. Mume, Bai, Japanese apricot-tree (Lauche). This species, a favourite plant of the Japanese, and as such largely grown in gardens and temple-groves, is cultivated chiefly on account of its blossoms. Its round, pubescent fruit resembles apricots in form, or rather small, hard peaches. It is hard and sour, and as a rule is eaten salted or dried, under the name Ume (Mume)-boshi or Haku-bai. It is also made into vinegar.

11. *Prunus tomentosa*, Thunb., Jap. Isora mume. The felt-leaf apricot-tree, as Lauche calls it,[1] is only a shrub with red fruit, looking and tasting like cherries. I saw the fruit for sale in Wakayama, and often observed the shrub which it adorns in the neighbourhood of dwellings in Kishiu. That the fruit of the Yamasakura (*Pr. pseudo-cerasus*, Lindl.), too, is eaten, as Siebold affirms, and of the Man'-zaku (*P. incisa*, Thunb.), as Kinch says, is unknown to me.

12. *Zizyphus vulgaris*, Lam., *var. inermis*, Bunge, Jap. Natsume and Sanebuto-natsume. In the Kew collection, under the title *Z. iujuba*, Lamk., there are specimens from China, Japan, India, etc., and seeds of this plant are said to have been found in an old Roman amphora, in London, in 1864. In ancient times it was widely grown in the civilized states of Asia. It is cultivated here and there in Japan, though not to the same extent as in Corea. Its trees grow unprotected to a height of 6 to 8 meters, blossoming in June, and bearing in autumn. Its oval or elliptical fruit is the size of olives, and has a yellow or reddish epidermis, which encloses a tart-tasting flesh, that is either eaten raw, or put to a medicinal use. In the northern provinces of China, where "jujubes" are extensively cultivated, they are preserved in honey, in which state they resemble dried dates in shape, colour, and taste, at least, if not in size. Hence one finds them often spoken of as "dates," or "Chinese dates," names which might easily occasion a misapprehension.

13. *Hovenia dulcis*, Thunb., Jap. Kempon-nashi. Kaempfer, who gives a picture of a branch with leaves and fruit, compares this tree, in passing, with a medium-sized pear-tree ("Am. Exot.," p. 808). It belongs to the same family as the preceding, but bears a totally different fruit, in so far as its singularly fleshy, thickened stems are concerned, though not the fruit itself. The sweet taste of these stems reminds one somewhat of our pears, and is much liked, especially by children. The tree flourishes quite well in the warmer parts of Europe.[2]

14. *Cornus officinalis*, S. and Z. (*C. sanguinea*, Thunb., *C. ignorata*, K. Koch.), Jap. Sanshiô-nayu, is cultivated here and there for the sake of its fruit. The big bushes, or little trees, which I found in the summer of 1875 growing near mandarin oranges in Yamato, reminded me forcibly of our common cornelian-cherry (*C. mas*, L.), which is closely allied to the scarlet, egg-shaped stone-fruit.

15. *Elæagnus umbellata*, Thunb. (*E. parvifolia*, Royle), Jap. Gumi. The umbelliferous olive, which is frequently found growing wild in Japan, though also cultivated for decorative purposes, bears a small, round, pink fruit, with a stone. Children especially are very fond of its flesh. The same holds true, though perhaps not

[1] Lauche: "Dendrologie." Berlin, 1880, p. 643.

[2] See Philippe: "Sur l'Eucalyptus globulus et l'Hovenia dulcis. Bull. Soc. Accl.," sér. 2, i. p. 196 (1864).

to the same extent, of the remaining species of Elæagnus, for which Gumi is the generic term.

(*c*) Berries.

16. *Diospyros Kaki*, L. fil., Jap. Kaki, Chinese Shi-tse, Fr. plaqueminier, Eng. persimon—the date-plum or lotus-plum tree. This Ebenacea, remarkable also on account of its wood, is undeniably the most widely distributed, most important, and most beautiful fruit-tree in Japan, Corea, and Northern China.[1] In Japan it endures night frosts, at a temperature of from −12° C. to −16° C. It can be cultivated high up in the valleys and far beyond the limit of the bamboo-cane. It is a stately tree, after the fashion of a pear-tree, with beautiful deciduous leaves, almost as large as those of some magnolias, but of bright-green colour and resembling those of the pear in shape only. The new leaves come in May, blossoms in June, the season of ripe fruit is late in autumn, from the middle of September to the end of November. Thunberg ("Flor. jap.," p. 158) strikingly describes this handsome berry (from the size of an egg to that of a man's fist), as follows:—

"Pomum subglobosum, obsolete tetragonum, glabrum, immaturum viride, maturum flavum, basi truncatum, calyce persistente ornatum, obtusum stigmate persistente, octovalve, octoloculare, magnitudine pomi mediocris, sapore fere pruni albi dulcis, carnosum."

There are many kinds of Kaki, ranging in size from a small hen's egg to a big apple. Some are nearly spherical, others oblong, others heart-shaped. In colour of the outer skin they run from light orange-yellow to deep orange-red. They are distinguished also by their taste, which is pleasant in its way and reminds one of tomatoes, as does the colour also. They are eaten not only in a soft, doughy condition, in which those of the Migako-no-djô, in the province Hiuga, are prized most highly, but the fruit is gathered while still hard, to ripen afterwards. The best in Japanese estimation are *Tarugaki*, *i.e.*, "tub persimons," which have been converted from astringent into sweet fruit by being kept in an old saké tub. The bitter, astringent taste of all green Kaki remains, even in the ripe fruit, in the case of most varieties, and it is from these that, during the summer, an astringent fluid, rich in tannin, is prepared (called Shibu), an acid of considerable importance in several industries. (See paragraph in the next section.) When over-ripe and dried in the sun, pressed somewhat flat, and then put away in boxes, the sweet Kaki get to look and taste in a few months, when skinned, like dried figs, and are used like them. The white powder which covers these dried persimons in boxes is natural sugar that has exuded from the fruit.

In September, the Kaki-tree, laden with large, orange-coloured

[1] Thus, for example, Markham, in his "Travels through the Province of Shantung," in the *Journ. Roy. Geogr. Soc.* (1870), says, "Persimmon-trees abound."

fruit, is a great ornament to the landscape. This beauty it preserves till it loses its leaves in October.[1]

The summer of Germany is not long enough or warm enough for Diospyros Kaki; its winter, as a rule, too cold. The tree and its fruit, however, do well about the lakes of Northern Italy—at Intra, for example, and on the Riviera, and in the sub-tropical parts of the Iberian peninsula. In Southern California, too, at Santa Barbara, for instance, it has been raised successfully.

17. *Diospyros Lotus*, L. (*D. Kaki*, Thunb. var. *β.*, *D. japonica*, S. and Z.), Jap. Shinano-gaki, that is, Kaki of the province of Shinano, is frequently regarded as a wild form of the foregoing species. Its small and indifferent-tasting fruit does not get ripe before late autumn, after the tree has cast its leaves. It resembles wild apples and wild pears.

The representatives of the *Aurantiaceæ* come next to date-plums in importance as berries, although their cultivation is limited to the warmer parts of Japan, and their use is by no means as general and multifarious.

First of all comes—

18. *Citrus nobilis*, Lour., Jap. Mikan, the mandarin orange. Its home appears to be China and Cochin China. As late as the beginning of this century, it was a novel feature in gardens in the countries along the Mediterranean. It is as easily distinguishable by the smallness of its growth (being a bush, rather than a tree) as by its well-known fruit. It has been grown in Japan for many hundreds of years. The northern boundary of its successful culture in Hondo is near Atami, and next to it in the Peninsula of Yamato. The mountains here, with spurs running southward, shelter the valleys from rude winds, and the influence of warm southern currents is felt. Mikan, therefore, is produced chiefly in the valleys of Ise and Kishiu, especially in the district of Arita (Arita-gori) north-east of Wakayama. The blossoming time here is the end of May and the early part of June. (In Malaga I have seen bushes in full bloom as early as April 7.) This region supplies the demand of the three Fu, or capital cities, particularly of Tôkio. Mandarin oranges come to Tôkio for sale in large quantities all through winter, and are cheap. They grow in many places in Southern Japan; but I never saw any large orchards.

19. *Citrus aurantium*, L.

(*a*) *C. a. Bigaradia*, Brandis and Hooker (*C. vulgaris*, Risso), Jap. Daidai, the bitter orange, called Seville orange by the English.

(*β*) *C. a. sinense*, Galisco (*C. aurantium*, Risso), Jap. Kunembo, the orange, thick-skinned and not highly prized.

[1] In the spring of 1884 I was strikingly reminded of its appearance when leafless by seeing some orange-trees near Cordoba, which had lost their leaves in consequence of an unusual degree of cold at the beginning of the preceding winter, but were still laden with frozen fruit.

20. *Citrus decumana*, L., Jap. Zabon, the shaddock. I found specimens of it from various parts of Bungo, in an exhibition at Funai. They differ considerably from those of Southern Europe in shape and size, and are especially inferior to the splendid shaddocks of the West Indian islands, where the family of the Aurantiaceæ undoubtedly attain their highest point of productiveness. More frequent still are the smallest of this family in Japan—the Kinkan, or fruits of

21. *Citrus japonica*, Thunb., which may be regarded as a transition to lemons and citrons. They become ripe in December and January, and are sent to market at Tôkio in great quantities. From 12 to 15 are sold for five farthings. That they are "valde dulces, grati et edules," as Thunberg affirms, is more than I can admit. They are rich in citric acid and always reminded me of *Citrus lima*, Risso (Eng. lime). Two varieties are distinguished, as Siebold also states.

(*a.*) Kin-kan, with spherical fruit about the size of a large cherry.

(*b.*) Tô-kinkan, *i.e.*, Chinese Kin-kan, similar in size, but oval in shape. Kaempfer compares the Kinkan, in form and size, not inappropriately, with nutmegs. They present a handsome appearance. Their smooth, light orange-coloured skin is dotted with green dimples, and is very aromatic. The flesh, however, is used like that of lemons, on account of its acidity.

C. aurantium microcarpum and *C. a. minimum*, Dierbach [1] seem to be identical with Kinkan (*C. japonica*, Thunb.). A note on the "Limonier du Brésil" in the old botanical garden, under an article in the *Revue Horticole* of 1880, treating of remarkable ornamental plants in Lisbon, probably refers to the same variety, for it says that the old tree bears small round lemons every year, as big as medium-sized plums.

22. *Citrus media*, Risso, Jap. Tebushiu-kan, the citron, var. *chirocarpus*, L., Jap. Bushiu-kan, oval, with a thick, lumpy and very aromatic skin. It is not frequent.

23. *Citrus medica Limonum*, Brandis and Hooker, Jap. Yudzu, the lemon of the English.

24. *Punica granatum*, L., Jap. Zakuro. This low tree is found, though but singly, much farther north than the Aurantiaceæ. I saw it as far north as Kaga and Aidzu in gardens; and in Yonezawa and Sendai I noticed the ripe fruit for sale, which was evidently grown in the vicinity. It was of medium size and did not taste as good as that raised in the Mediterranean region.

25. *Ficus carica*, L., Jap. Ichijiku and Tô-kaki, *i.e.*, Chinese Kaki. According to Thunberg, the common fig-tree was introduced by the Portuguese. Its cultivation, however, remained only limited. In China, too (according to Williams), the Portuguese tried to

[1] Dierbach: "Grundiss der allgemeinen ökon. techn. Botanik." Heidelberg, 1836.

popularize fig-culture, but without success, as the fruit did not have a pleasant taste.

26. *Morus alba*, L., Jap. Kuwa. The fruit of the different sub-species of this plant, the silk-worm mulberry, is seldom eaten. It is not always white. There are some varieties with black berries, as was noted by Kaempfer. Thunberg surely misunderstands him when he adduces *Morus nigra*, L., and refers it to Kaempfer. The edible black mulberry is not found in Japan.

27. *Vitis vinifera*, L., Jap. Budo. Grapes are offered for sale, late in autumn, in almost all Japanese towns. There are two sorts, one white, and a red one resembling Muscatel. These grapes are thick-skinned, not so sweet as ours, and have a bitter, strange after-taste. Kaempfer was not unjust when he declared them unfit to make wine of.[1] There is a good deal of probability in favour of Thunberg's assumption that they were first introduced by Europeans (probably Portuguese). Like other fruit, they have degenerated, and this fact almost excludes any hope that Japan, or East Asia in general, will ever become a wine-growing country.

The Koshiubudo, *i.e.*, Koshiu-grapes, so highly prized in Tôkio, come mostly from Katsunuma and several other places near Kôfu. They are here grown on arbours, like the pears of Kawasaki, and do not get ripe till September, as I noted in the autumn of 1874.

28. *Vitis Labrusca*, L., Jap. Yama-budo, *i.e.*, wild grapes growing on the mountains. This species, with its little blue berries and its peculiar flavour, resembles the small early Burgundy, and is frequently on sale in the towns. *Vitis Labrusca*, L. is distributed in Eastern Asia very much as it is in the Atlantic forest-lands of North America.

After this berry comes a long list of others, which take the place of fruit with the Ainos, for example, and are also eaten in Japan Proper, and sometimes exhibited for sale. The following are those most worthy of notice:

29. *Akebia quinata*, Decaisne (*Rajania quinata*, Thunb.), Jap. Akebi, and

30. *A. lobata*, Decaisne, Jap. Mitsuba-akebi, *i.e.*, trefoliate Akebi. The fruit of the Akebie resembles small cucumbers, and usually are set in pairs facing each other on a long stem, thus recalling forcibly the product of *Holbœllia latifolia*, Wall., of Sikkim. It ripens in September, when it averages 10 cm. in length, and 12 to 15 cm. in girth; is white, grey or brown, and elliptical in shape. It springs up lengthwise. Its exterior fleshy coating, under the husk, is not good to eat. A white, transparent, mucilaginous mass with a sweet pleasant taste surrounds the countless little seeds, and is all that is edible. It is common in autumn to see the husks of Akebie lying along the path, and to meet women and children busy gathering this peculiar fruit.

[1] "Adeoque ad œnopæiam haud idonea."—Am. exot. p. 786.

31. *Actinidia arguta*, Planchon (*Trochostigma arguta*, S. and Z.), Jap. Kokuwa, Shira-kuchi-katsura, and Saru-nashi (monkey pear), is like all Actinidiæ a deciduous climbing shrub, which is fond of insinuating itself into the crowns of low trees, whence it hangs down with its numerous branches and plentiful fruit. Its white blossoms resemble in shape those of the tea-plant, and appear in June. The berries ripen in autumn, and are like gooseberries in appearance and size. When over-ripe, they smell like pears. Böhmer found their taste pleasing, a combination of the flavour of figs and grapes. I have eaten them several times, even when over-ripe, finding them in this condition not so agreeable.

32. *Actinidia polygama*, Planchon, Jap. Matatabi, is a climbing shrub of frequent occurrence in thickets. Its soft, ripe berries, with five-fold green calyxes, are of elliptical form; in this, as in size and the manner in which they taper off, bearing a resemblance to acorns. Its flesh is yellow and filled with small seeds, and is not eaten, as far as I know, although Kinch says this fruit is edible. The whole plant, however, has a remarkable property—like Valeriana officinalis—it attracts cats! This is referred to in a well-known Japanese saying:

"Neko ni matatabi," which means as much as: "He can't let it alone, any more than a cat (neko) can matatabi." Both of these Actinidiæ exist now among us as ornamental climbing shrubs.

33. *Rubus*, Jap. Ichigo. Among the twenty-two species represented in Japan, belonging nearly all to the raspberry-group, there are only a few with edible fruit. Siebald enumerates six, Kinch eleven; but several should certainly be struck out of their lists. The raspberry proper, *Rubus Idæus*, L., var. strigosa, seems to be restricted to a few localities in the island of Yezo, and so, too, with the whortleberry or moss-berry *R. chamæmorus*, L., which is so general on the moors of Northern Europe. In addition to them, Kinch mentions, *R. triflorus*, Richards, *R. Buergeri*, Miq., *R. corchorifolius*, L. fil., *R. incisus*, Thunb., *R. cratægifolius*, Bunge, *R. trifidus*, Thunb., *R. Thunbergii*, S. and Z. *R. parvifolius*, L., *R. tokkura*, S. and Z. I have tasted the products of most of these varieties and found them insipid.

34. *Fragaria vesca*, L., also called Ichigo in Japanese. I have only once found ripe, well-flavoured strawberries in Japan, and then it was on Fujisan. I have never seen either wild strawberries or those raised in gardens offered for sale, which is proof enough of their rarity. The name Oranda-ichigo for *Fragaria chilensis*, Ehrh., and *F. grandiflora*, Ehrh., the pine-apple strawberry, points to the introduction of these species by the Dutch.

35. *Rosa rugosa*, Thunb., Jap. Hama-nashi, *i.e.*, coast-pear. The large onion-shaped heps or false fruit of this beautiful dune-plant are eaten, not only by Ainos, but also by Japanese.

36. *Vaccinium*, L. From this division the blackberry and the blueberry (*V. Myrtillis*, L., and *V. uliginosum*, L.) are absent altogether,

while among the sour red-berry species of any account, the cranberry (*V. Vitis Idæa*, L.), Jap. Koke-momo and Iwa-momo, and the moss-berry (*V. oxycoccos*, L.), Jap. Aka-momo and Iwa-haze appear only sporadically, and seem confined chiefly to Yezo, so that they do not attain to any great importance.

37. *Epigaæ asiatica*, Maxim. (*Parapyrola trichocarpa*, Miq.), Jap. Iwa-nashi, *i.e.*, rock-pear. To what extent its berry, which reaches the thickness of a small cherry, is capable of being used for food, I cannot judge. The plant, however, which till now has been very little known, deserves closer attention, on account of its beautiful evergreen leaves and its blossoms, which come out in March and April. It is a small, evergreen, creeping shrub. I found it in the woods about Kiôto, and according to Keiske it occurs also in Owári, and has been discovered, besides, in the north.

(*d*) Nuts.

38. *Castanea vulgaris*, Lamk. (*Fagus castanea*, Thunb.), Jap. Kuri. When one considers how quickly the chestnut becomes wild, even in Germany, *e.g.*, in the Black Forest and along the Hardt in the Palatinate, it is possible to grasp the difficulties attending any attempt to determine the border-line between its range as a cultivated tree and as a spontaneous growth. Is it, for example, native or gone wild in England, the Caucasus, Japan, and North America? Various reasons are in favour of the former supposition. Basing his argument on them, de Candolle says in his book on "L'origine des plantes cultivés," already so often cited: "Le Châtaignier, de la famille des Cupulifères, a une habitation naturelle assez étendue mais disjointe," and very properly regards the differences between the chestnut of the North American Atlantic forests, that native to Japan, and that found in the western part of the Old World, as too slight to justify a specific distinction. We therefore regard *C. vesca*, L. as only the cultivated form of *C. vulgaris*, Lamk., which has differentiated from it not only in Europe and Western Asia, but also in Japan, independently.

What Radde says about the occurrence of the chestnut in the Caucasus, is of force also with regard to Japan. The tree seeks light and shuns hot plains. It seldom exists in solid, homogeneous masses, but appears in scattered groups, in sapling thickets and brushwood. In Japan it forms thin groves, especially on mountain slopes surrounding valleys, and adjacent to the higher-lying forest of various kinds of trees. It attains there an altitude of more than 800 m. above sea-level. In June, when its whitish yellow catkins are developed, these thin chestnut groves stand out everywhere sharply from the surrounding woods, as one may see at Heidelberg Castle. Chestnuts are not used as food to such an extent in Japan as elsewhere, and are devoured mostly by wild swine. I found them cultivated here and there in northern Hondo (once even in a village as an umbrageous tree), but most frequently in Yonezawa, where, too, that variety has been evolved which we call Marrons. This, as is well known, is distinguished by the fact that each burr, instead of holding two or three nuts, contains only one, which is proportionally large.

39. *Juglans regia*, L. (*Pterocarpa japonica*) and

40. *Juglans Sieboldiana*, Maxim. (*J. nigra*, Thunb., *J. mandschurica*, Miq.). Both kinds of walnut are called Kurumi in Japan and are, perhaps, only found cultivated. They grow over a wide area, though nowhere plentifully.

41. *Corylus heterophylla*, Fisch. (*C. Avellana*, Thunb.), Jap. Hashibami, mostly growing wild, but also cultivated. *C. rostrata*, Ait., is more rare.

42. *Quercus cuspidata*, Thunb., Jap. Shii. The small acorns of this very frequent, evergreen species are sold under the name of Shii-no-mi (Shii-seeds) and eaten roasted.

43. *Pinus koraiensis*, S. and Z. (*P. Strobus*, Thunb.), Jap. Goyô-no-matsu. The seeds of this pine (probably only found cultivated) are eaten, like those of the sweet-pine. For this purpose the crop of cones is publicly sold by auction at the castle of Morioka in Nambu.

44. *Torreya nucifera*, S. and Z., Jap. Kaya. The edible nuts are used chiefly to make oil. (See Kaya-no-abura.)

45. *Ginkgo biloba*, L. (*Salisburia adiantifolia*, Smith), Jap. Icho or Ginkiyo. Its fruit is called Ginnan (in China Pa-Kwa). It is really stone-fruit, of the same size, shape, and colour as large mirabelles, with thin, disagreeable flesh, and seed-kernels of which the taste is not unlike that of almonds. According to Fortune, Ginnan are bought and sold in all the markets in China, and they are no less highly esteemed in Japan, though in the latter country the tree is not grown for their sake as in China, but for ornamental purposes. (See ornamental plants.)

46. *Trapa bispinosa*, Roxb., Jap. Hishi. The double-thorned water-nut or water-chestnut is found in stagnant water in Eastern Asia, from Cashmere to Japan, sometimes growing wild, sometimes cultivated for its fruit, especially in China. In Japan I often saw it in weirs, particularly those which are used in watering rice-fields. The variety *Trapa incisa*, S. and Z. (*T. natans*, Thunb.), Jap. Himebishi, is also of frequent occurrence.

47. *Nelumbium speciosum*, Willd. (*Nelumbo nucifera*, Gaertn.), Jap. Hasu. The elliptical nuts, Hasu-no-mi, as large as a small acorn, of a greyish brown externally but white within, and having an agreeable nut-like taste, have already been mentioned.

(f) *Articles of Food and Luxury as Chemical Products of the Raw Materials mentioned under* 2 (a)—(e).

Under the heading "Alimenta composita," Siebold, in his catalogue of useful Japanese plants, which we cited above (p. 36), names a number of preparations which are in part peculiar to that country, and are of great interest from the way in which they are obtained and utilized. In the domestic economy of the Japanese —and of the Chinese, too, to some extent—several of these have played for centuries the indispensable *rôle* of condiment to their food, making even the most insipid agreeable to the taste. In this way they have excited attention and imitation, more or less, in Europe, and especially in England. Others find a place as valuable articles of diet, being qualified, by their large proportion of nitrogen, to take the place of meat. Others again contain sufficient alcohol and admixtures of it to produce exaltation and make the head heavy —a gratification which, it seems, many people even in Eastern Asia cannot deny themselves. And for these intoxicating drinks the Government shows an interest scarcely second to that taken by Christian States themselves, in that it has for a long period been drawing revenue from them. Thus there is no lack of the necessary statistics in regard to production and consumption. In this respect, at least, intoxicating drinks take precedence of all other of these products, so I set them at the head of the following list and now proceed to them.

1. Saké or Seishû is the intoxicating beverage *par excellence* of Japan and both its western neighbours. It is prepared from rice, as is well known, but has little resemblance to the Indian arrack. And the terms "rice-beer" and "rice-brandy" so often applied to it do not properly characterize it, for Saké differs widely from beer and brandy, especially in the quantity of alcohol contained; like wine, occupying in this respect a place mid-way between them. Foreigners seldom relish the peculiar taste of Saké. The Japanese, however, like it so very much that they in their temple-feasts do not fail to set some of it before the gods, with their favourite food, in ancient fashion. This dedicated Saké is called Miki[1] or ô Miki. The inhabitants of Japan are universally fond of hot drinks, be it even warm water, in default of tea or Saké, and so they prefer this liquor heated, and drink it from their small cups of porcelain or lacquered wood.

In 1874 Chief Staff-surgeon Hoffmann gave the first short account of Saké manufacture, from personal observation.[2] Four years later there followed a more comprehensive, scientific work on the subject by Korschelt,[3] and at last, in 1881, a second, by Atkinson, a treatise of great merit,[4] which supplements that of Korschelt in many places, and has been made use of, with it, for what follows here.

[1] Mi is a prefix of honour, as in Mikado, Midera, and Ke or Ki is the oldest name for Saké.

[2] "Saké- und Myrin-Bereitung," von Hoffmann. "Mitth. der deutsch. Gesellschaft Ostasiens." 6. Heft, 1874.

[3] "Ueber Saké," von O. Korschelt. 16. Heft. 1878, von den "Mitth. der deutsch. Ges. Ostasiens."

[4] "The Chemistry of Saké-brewing," by R. W. Atkinson. "Memoirs of the Science Department, Tôkio." Daigaku, 1881.

It seems that the Japanese became closely acquainted with Saké at the beginning of the third century, during their first expedition to Corea. At least, the introduction of its manufacture is assigned to that date. It was a Chinese process, and was, too, further perfected by the Chinese. For many centuries great difficulty was experienced from the summer heat, which quickly spoiled the liquor. Then, about 300 years ago, a means of preserving it was discovered in the very heating. In those days the Saké-distilleries at Itami and Nishinomiya on the road (now railway) from Hiogo to Ôzaka, and from Ikeda, had already attained a great reputation, which they have kept up to the present time, despite all competition.

However much the process may differ in a few secondary respects, it is still to all intents and purposes, the same in all distilleries. Common rice (Uruchi) is everywhere employed, and always in its hulled shape, never the glutinous rice, though perhaps that is simply because it is considerably dearer.

After the Japanese example, Korschelt notes four stages in the manufacture of Saké, namely 1, the production of Kôji; 2, of Moto; 3, the main process; and 4, pressing and clarifying. Atkinson entirely separates the preparation of Kôji from the three other subjects, treating them together under the head of Saké-brewing proper.

a. Preparation of Kôji or rice-ferment. The means by which in making Saké the farinaceous meal of the rice-grains is transformed and got ready for alcoholic fermentation is called Kôji, being thus similar to diastase in the case of malt. It is, moreover, applied also in the manufacture of Shôyû, and in other cases likewise where we should use lees, and hence its production is a thing by itself, and not merely a part of Saké-distilling.

Kôji still has essentially the look of the hulled rice-grains from which it was made, except that most of these grains are now loosely united in lumps of greater or less size. This lumping takes place through the Mycelium fibres of a mould-fungus (*Eurotium Oryzæ*, Ahlburg), which pierce into the loosened cellular layer, while the walls in the thicker cells about the centre of the mass have acquired a horny character, so that the single starch-grains are no longer distinguishable. By prolonged contact with water a considerable number of these Kôji-grains are dissolved, colouring the fluid yellow. This change is effected still more quickly and completely in warm water, so that often only the cell-walls and Mycelium filaments remain undissolved. In this way between 30 and 60 per cent. of the Kôji passes into solution. As Atkinson has shown, this soluble part of the Kôji consists principally of starch-sugar and dextrine, the mutual relation of which is, of course, subject to many variations, depending upon the temperature and the duration of the influence of the fungus. By Tane-kôji, *i.e.*, Kôji-seeds, is meant a fine yellow powder, the spores of the fungus, as revealed by the microscope.

Saké is manufactured only in the coldest months, from November to February, and Kôji in the same season. But preparations are often made as early as October. The hulled rice is first of all washed with fresh water, the latter being renewed so long as it gets a milky colour from the rice. Then it lies one night in the last bath of water, thus becoming soft. Steam does the rest. This is made in an iron boiler and then let loose amid the rice, so that there is no possibility of sprouting and developing diastase, as in the preparation of malt with us.

When the steamed rice has become so soft that it is easily kneaded into dough between the fingers, it is spread out on straw mats to cool. There, when reduced to blood-heat, it is treated with Fane-kôji, a teaspoonful of the latter to 4 To (73 liter) of rice. In making the mixture, the fungus-spores are first thoroughly mingled with a small portion of the rice-mass, after which the compounding of the whole body is undertaken.

The rice thus spread out is now left for about three days on mats in warm rooms, for the development of the mould fungus. In factories built expressly for the manufacture of Kôji, these apartments are subterranean chambers 8 to 10 m. long, 2½ m. broad, and 1½ m. high, made in a clay soil 3 to 4 m. under ground. They communicate with the entrance to a square shaft 3 to 4 m. deep, and 2 m. wide, by means of low, narrow passages, whose openings are hung with straw mats. The purpose of this whole arrangement is evidently to preserve the high temperature in the chambers unchanged as long as possible.

Along both of the side walls of every chamber a bank of earth is left, ½ m. high, and near the entrance to the chamber there is a depression, in which the mats are laid with the rice wrapped up in them, and kept all night at a temperature of 25–26° C. Next morning the rice is manipulated to prevent its balling together. Towards afternoon it is found covered with the Mycelium of the fungus as with a white blanket. It is now shaken out into baskets frequently sprinkled with cold water, while being tossed about. It is next laid out on boards and partitioned off with racks, the boards being put side by side on the banks in the chambers. During the day and a half in which the rice remains here, it is thoroughly mixed by hand several times, to separate the grains which have stuck together. Finally, on the morning of the fifth day (counting from when the rice was washed), the boards with the finished Kôji are taken out of the chambers and put away, one above the other, in a cool, airy place, to await sale or use. The Kôji last in this way several months without being spoiled by the formation of spores, which announce their presence by yellow spots. When the chambers have a temperature of 20° C, that of the rice rises to 25–28° C. because of the development of fungus, and in the morning even higher, for then the fungus grows faster than in the afternoon.

In Saké distilleries Kôji is prepared in precisely the same way, only that the chambers are smaller and not sunk so deep in the ground. Tane-kôji is made only in spring. The spreading of fungus is allowed to go on one or two days longer than in the preparation of Kôji, but it is finally covered over. The spores thus obtained are kept all the summer in a sealed, air-tight pot, in a dry, cool place, until needed in autumn. In winter the Kôji itself is used instead of it.

b. Preparation of the Moto, or mash. This is a turbid fluid, which Hoffmann has called Mutterwürze, although neither this word nor "mash" is a proper translation of "Moto." It is a product of the fermentation caused in Kôji by heat,—a fermentation whereby a considerable part of the rice-starch is converted into dextrine, starch-sugar, and finally alcohol. Its production takes about fourteen days and is accomplished when the development of carbonic acid in the ferment has grown considerably less and the liquid has lost its former sweet taste and become sour and bitter, with a pronounced flavour of alcohol.

In Saké distilleries a fresh supply of rice is steamed on the third or fourth day, the preparation of Kôji having begun at the commencement of November, and is spread out on mats till the following morning. Then it is made into a thick porridge, with Kôji and water. The proportion of these ingredients, which does not vary much, is quantitatively: rice 10, Kôji 36, water 11·1; and, according to weight, rice 10, Kôji 4, water 12. The rice thus steamed, as well as that used for making Kôji, is dried and hulled. In the celebrated distilleries at Itami and Nishinomiya, 0·5 Koku of steamed rice are mixed with 0·2 Koku of Kôji and 0·6 Koku of water, and this compound is called a Moto. This Moto is divided into six equal parts, and put into six flat, cylindrical wooden tubs, called Han-kiri, each holding 100 liters. The tubs are filled to only about one-fifth of their capacity. The mass is now kneaded and mixed by hand into a stiff, thick paste for two hours, after which it is left to itself twenty-four hours, in which time it completely loses its stiffness, becoming thinner and more easily worked. Now a sort of oar or ladle called Kai (oar), is dipped in and for several days the mixture is frequently stirred thoroughly with it. The milky liquor which is increasingly produced indicates starch-sugar by its sweetness, for a large proportion of starch has been meanwhile thus converted. But near the end of this process carbonic acid becomes more and more perceptible, indicating that alcoholic fermentation has already set in, despite the low temperature. For all this time the temperature has been that of the outer air, varying from 0° to 10° C. Korschelt calls attention to the fact that this coolness of the atmosphere is probably necessary and that, under the given conditions, Saké-making is for this reason confined to the coldest four months, since spores of the fungus (*Eurotium Oryzæ* Ahlb.) would otherwise appear in the Kôji.

At the latest in six days, this process is completed. The contents of the Han-kiri, three at a time, are poured into a fermenting vat (Moto-yoshi-oke), holding about 6 hl., and here the stuff is left quiet for one day. Then comes the warming of the mash, to hasten alcoholic fermentation. Wooden vessels of a conical form, closely stopped, are filled with boiling water, dipped into the mass of grain, and moved about hither and thither. They measure 30 cm. at the bottom, 23 cm. at the top, and are 50 cm. high, and every Daki has a handle fastened to two ears that project over its upper edge.

After about twelve hours the vessel, having cooled, is replaced by another full of boiling water, and thus it goes on, at longer or shorter intervals, according to the heat required, till the fourteenth day, the last of the Moto-preparing. During this time the fermentation vats have been wrapped in straw mats, to diminish cooling from outside as much as possible. Within, the temperature gradually rises to about 25° C., for the most part through increasing fermentation—in other distilleries even to 30° C. When the process of fermentation is nearly finished, the contents of the vats are put back into the Han-kiri, and there left to cool off gradually.

The composition of prepared Moto is, of course, very varied. The proportion of alcohol for example, ranges from 3 to 14 per cent. Atkinson found in Moto from Nishinomiya 10·5 per cent. of alcohol, 0·2 per cent. of starch-sugar, 0·56 per cent. of acid, 16·58 per cent. of starch and cellulose, and 72·16 per cent. of water.

c. The main process. For this the plant and method are nearly the same everywhere. In practice three kinds of bucket-shaped vats are employed, one after the other. They widen out somewhat at the top, and their height is 15 to 25 cm. less than their diameter at the middle. According to their depth they are distinguished as San-shaku-oke, Shi-shaku-oke, and Roku-shaku-oke, *i.e.*, three, four, and six-foot tubs. They hold about five, ten, and thirty-three Koku respectively, or twice that number of hectoliters. When in use, however, they are never more than half filled, so as to leave room for fermentation. They are as a rule made of soft Sugi-wood (Cryptomeria).

The process of fermentation is divided in the larger distilleries into three stages, called Soye, Naka, and Shimai (joining, middle, and end). Again steamed rice (Mushi-han), Kôji, water, and this time Moto besides are used in Soye, in the following preparation :—

	at Itami.	at Nishinomiya.
Mushi-han	1·30 Koku	1·05 Koku
Moto	1·30 „	1·33 „
Kôji	0·35 „	0·35 „
Water	1·30 „	1·15 „
	4·25 Koku	3·88 Koku

The mixture is transferred to a San-shaku-oke in the above proportion, and there for two or three days thoroughly stirred once every two hours. During this time of increasing fermentation, at a temperature of about 20° C. (when the air outside is at 10° C.), there arises a pleasant, aromatic, pungent odour. The Soye is now completed. The mass is divided equally and put into two other three-foot tubs, where a fresh lot of steamed rice, Kôji and water is added, according to the following proportions :—

	at Itami.			at Nishinomiya.
Soye	4·25 Koku	...	...	3·88 Koku
Mushi-han . .	2·00 „	...	...	1·80 „
Kôji	0·65 „	...	...	0·60 „
Water	2·90 „	...	...	2·40 „
	9·80 Koku			8·68 Koku

Thus in Itami 4·90 Koku, and in Nishinomiya 4·34 Koku, are put into each of the two tubs. This mixture also is vigorously stirred every other hour, though for one day only, and then the Naka is finished. Once again the fermented stuff contained in each tub is divided and put into two others and mixed anew with steamed rice, Kôjî and water. The proportions of the new mixture, for Shimai, the last stage of fermentation, is as follows :—

	at Itami.			at Nishinomiya.
Naka	9·90 Koku	...	...	8·68 Koku
Mushi-han . .	3·30 „	...	...	3·60 „
Kôji	1·00 „	...	...	1·20 „
Water	4·20 „	...	...	6·20 „
	18·40 Koku			19·68 Koku

Half of this mass is therefore contained in each tub, and is there treated as in the former two cases. Three days afterwards the entire four tubfuls are put one by one into a big Roku-shaku-oke, where a much brisker fermentation sets in, gradually decreasing however in two or three days. The scum settles, the liquor is strongly alcoholic, and ready now for the last operation.

d. Pressing and Clarifying. In squeezing the fluid body of mash, which still keeps on slowly fermenting, a machine is used similar to the lever press employed for the Shôyû (See No. 6 of this section). It is poured into close woven bags of hemp-linen, strengthened with Shibu,[1] which are then laid side by side, and

[1] Shibu is the juice of unripe Diospyros Kaki fruit, rich in tannic acid.

crosswise one above another in a strong square box, and covered with a plate, smaller than the bottom of the box, or with several one over another, decreasing successively in size. Upon this lid there presses a one-armed lever, in the shape of a long beam, one end of which is hinged in a stout post, while the other is weighted with a load of 600–900 kg. On the front side of the box, near the ground, is the spout arrangement, through which the turbid Saké is conducted into a vessel that stands below. For clarification it is put into a standing cask, having two bungholes close together and one above the other, near its lower head. The Saké stands here quiet for two weeks, in which time all solid impurities sink to the bottom. Then, when the upper stop-cock is opened, the Saké flows off clear from the underlying sediment. It is poured into barrels or closed tubs, and now only needs to be heated on the approach of warm weather, to become cured, as pointed out at beginning.

2. Shôchû (Shôchiu). Saké contains, as the following Table of analyses shows, 11–14 per cent. of alcohol. By a simple arrangement, a liquor is distilled from the dregs in the press, consisting principally of starch and cellulose, and containing 6 per cent of alcohol. It bears the name of Shôchû, and presents 20–50 per cent of alcohol, corresponding, therefore, more to gin than to spirits of wine, although the word is usually translated into "alcohol." Shôchû is principally made into Mirin. One kind of Shôchû, made in Kiushiu, and particularly in Satsuma, bears the name of Awamori.

3. Shiro-Saké, white Saké, is a white, sweet drink, with the appearance of milk, which is manufactured by converting glutinous rice (*Oryza glutinosa*) into meal, mixing this with water, and adding a little Saké. On Hina-matsuri or Sangatsu-no-sekku, the festival of dolls,[1] it is placed before the dolls and their friends.

4. Mirin is a sweet liqueur, ranging from yellow to brown in colour, and of the consistency of oil. It contains as much or more alcohol than Saké, and has an aroma peculiar to itself, though produced by the addition of foreign substances. It lasts for many years. When old it is called Komirin, old Mirin, and is then darker, sweet, and more highly prized.

Great quantities of Mirin, under the name of Toso-shû, or Toso, are drunk in every house after the first congratulations at New Year, not only by every member of the family, from youngest to oldest, but also when the mutual New Year's calls are made.

Its manufacture is usually connected with that of Saké. One large distillery, celebrated for its Mirin, is that at Nagare-yama, on the Yedo-gawa, about twenty-three English miles north of Tôkio. Steamed Mochi-gome or glutinous rice, Kôji, and Shochû

[1] See Rein, "Japan," i. p. 439.

are used in producing it, though never in the same proportion. At Itami, for example, 9 Koku of Mochi-gomi are mixed with 3·3 of Kôji and 14 of Shôchû; at Nagare-yama, on the other hand, 13 parts of Mochi-gome with 4½ parts of Kôji and 10 of Shôchû. The mixture is stirred once every two days in great vats, the rest of the time kept covered. It contains too much alcohol to reach fermentation, but merely converts a part of its starch into dextrine and sugar.

In 20 to 40 days the process is brought to an end, and the stuff pressed. The Mirin is then clarified after the manner of Saké, and put away for any desired length of time, in closed vessels.

SUPPLEMENTARY.

(a) *Chemical Composition of Saké, Mirin, and Shôchû according to Analyses by Atkinson.*

	SAKÉ.			
	I. At Itami.	II. At Nishinomya	III. Mirin.	IV. Shôchû.
Specific gravity . . .	0·992	0·990	1.085	0·94
Alcohol	12·42	12·45	12.98	39·63
Starch-sugar	0·48	0·56	21·04	—
Dextrine	0·23	0·22	4.16	—
Glycerine, gum, ashes	1·75	1·69	—	—
Free acid	0·18	0·19	traces	—
Volatile acid . . .	0·02	0.01	traces	—
Water	84·92	84·88	61·82	60·37
	100·00	100·00	100·00	100·00

I. is the average of four analyses of Saké from Itami.
II. is the average of five analyses of Saké from Nishinomiya.
III. is the average of eight analyses of Mirin from various sources. Its proportion of alcohol varies from 10 per cent. to 18½ per cent., and of sugar from 17·8 per cent. to 30·1 per cent.
IV. is the average of five analyses of Shôchû, in which the proportion of spirit ranges between 26 per cent. and 50·2 per cent.

b. *Statistical Information in regard to these Alcoholic Drinks.*

In the year ending, September 30th, 1880, exclusive of foreign importations,[1] 5,207,970 Koku (9,389,970 hectolitres) of alcoholic liquors were taxed in Japan. The state's total revenue from this source amounted to 6,459,570 yen (about £1,291,014). Counting the population as 34,000,000, there were to each person 27·6 liters of spirituous liquors, and a tax of about ninepence. Since then the tax has been doubled, without decreasing the production and consumption. The foregoing quantity and taxation is divided as follows:

	Tax per Koku	Number of Koku.	Government revenue in yen=4 shillings.
Common Saké (Seishû) . . .	1 yen	5015084	5015084
Turbid Saké (Nigori-Sake) . .	0·3 "	65494	19648
White Saké (Shiro-Sake) . . .	2·0 "	1500	3000
Sweet Saké for drinking and cooking (Mirin).	2·0 "	38569	77138
Meishû liqueur (a kind of Mirin)	3·0 "	3615	10845
Brandy (Shôchû).	1·5 "	83708	125562
		5207970	5251277
From licences to breweries and retail shops.			1208293
		Total	6459570 yen

5. Ame is an impure starch-sugar, mixed with dextrine and water, which comes to market in two forms, namely: first under the name of Midzu-ame (water- or fluid-Ame), with a large proportion of water, as a very thick, yellow syrup, and second, Ame proper, a doughy substance, very elastic. This latter, drawn out into round or prismatic sticks, making a favourite dainty, has a great attraction for children, especially when the man who sells it in the streets is at the same time an artist, and forms all sorts of figures from the white or coloured stuff heated till it is plastic. No sooner is heard the sound of the little bell, or the triangle which he holds in his hand, and the cry "Amai! Amai!" (Sweets! Sweets!), or "Amai to karai" (Sweet and biting), or some other well-known shout, than he is sure of a respectable following.

In house-keeping Midzu-ame often takes the place of sugar, and

[1] These go mostly to the account of Europeans and Americans.

has various applications. It is of service in dyeing also, and in the manufacture of Mirin. The best sort is of a clear yellow colour. It is usually made from Italian millet, and therefore called Awa-no-midzu-ame.

Ame and Midzu-ame are manufactured from Italian millet (Awa), glutinous or cooking-rice (Mochi-gome), or common rice (Uruchi). Its production has been minutely described by R. W. Atkinson,[1] so that simply referring to his work, I here give only its essential features.

First the grain is put into cold water, until it swells ; then it is cooked soft with steam, which is produced in an iron boiler ; then poured into flat wooden tubs and covered with mats, till a considerable quantity has been spread out in this way. Barley-malt, Jap. Moyashi, which is prepared similarly as with us, except that it is given more time to sprout and is soaked in water before use, is now mixed with soft grain and warm water, and the compound, at a temperature of about 60° C., is put into a wooden vat and left there at least six hours. The hulls and other insoluble substances settle to the bottom, the clear fluid, Midzu-ame, collecting on top of it. It is carefully drawn off, but from the dregs a second, inferior quality is obtained, by squeezing them in hemp-linen bags.

The proportion in which the component parts of this mixture are taken depends upon the nature of the farinaceous substances, and other considerations. But on an average, 5 To of steamed grain, 5 Shô ($\frac{1}{2}$ To) of malt, and 8 To of warm water go together. If the rice has been previously bruised, or if the malt is composed of the fallings-off in husking, the quantity of malt required will be less. On the other hand, however, it is apparent that a freer use of malt will effect the conversion of a larger amount of starch into dextrine and sugar, and thus produce a sweeter Ame.

The fluid obtained by decanting is Midzu-ame, very much thinned. To concentrate it, it is quickly steamed to the required consistency. This is done in iron pans, and lasts three to six hours, though a somewhat longer period is necessary to obtain the firm, white Ame, which is always prepared from rice, especially glutinous rice. The stiffened mass is at first transparent. It is rolled on boards into stiff ropes, which are drawn out and worked until there appears an opaque white colour, and it no longer sticks to the fingers. By this method of manipulation its volume is so increased that finished Ame swims on water, while Midzu-ame sinks immediately.

The following table has been calculated and constructed from Atkinson's analyses of the various sorts of Ame. I. is the average of six of them ; II., III., and IV. of two each. The rest will explain itself at a glance.

[1] "Transactions As. Soc. Japan," vol. vii., pp. 313–322.

	Per Cent. (*a*) In the Natural State.			Per Cent. (*b*) Dried at 100° C.	
	Water.	Dextrine.	Malt-stuff.	Dextrine.	Malt-stuff.
I. Awa-no Midzu-ame	16·51	21·19	16·51	26·50	73·50
II. Mochi-no „ „	19·16	7·34	73·50	9·07	20·93
III. Uruchi-no „ „	19·72	6·19	74·08	7·72	92·28
IV. Solid Ame	9·75	15·54	74·71	17·14	82·86

6. Shôyû, the Japanese bean-sauce, also called Soja, English Soy, both being corruptions of the Japanese name, is a dark-brown fluid with a pleasant aromatic odour and a peculiar salty taste. It foams up yellow when shaken, and leaves behind on the side of the glass a clear shining line of a fatty appearance, so that the Japanese designation "soy-oil" (Shô = soy, yû = oil) is quite appropriate. Its specific gravity, which Kinch gives as 1·199, may vary not inconsiderably, according to the method of its production. The same author found in 1 liter, as the total weight of the solid remnant 359·88 grammes, ashes (chiefly chlornatrium) 195·16 gr., sugar 31·03 gr., nitrogenous matter 41·00 gr., free acid (acetic acid ?) 6·20 gr.

For the manufacture of Shôyû, as I became acquainted with it in Kiôto, they use wheat (Ko-mugi), light-yellow Soja-beans (Shiro-mame), common salt (Shio or Shô), and water (Midzu); the first two in equal parts, three parts of water, and five or six parts of salt. In other places they take equal volumes of all four components. A small portion of the wheat is brought to fermentation with Kôji (rice-ferment); the rest is roasted to a delicate light-brown in iron pans over a fire of coals, and then ground in little hand-mills. The Soja-beans are boiled soft for about half a day with a little water, in iron kettles, and after that pounded to mush. Flour, bean-mush, and the fermenting wheat are now thoroughly mixed, poured into little wooden boxes, and exposed to fermentation for three days in a suitable room, at as uniform a temperature as possible (25° C.), whereby the mass becomes covered with mould-fungus.[1]

It is then immediately put into vessels open at the top; the required amount of salt and water is added and thoroughly mixed in, producing a paste. This is transferred to large open butts, like the mash-tubs of brewers. According to Hoffmann,[2] each of these can contain 20–30,000 liters. I found them considerably

[1] According to Hoffmann, "Mittheilungen der Ges. Ostasiens" 6 Heft, p. 98, the grains of wheat are only coarsely ground, and the beans are not pounded down, so that the formation of diastase takes place, as in the production of malt with us.

[2] "Mitth. d. deutsch. Gesellschaft Ostasiens," Heft 6.

smaller in Kiôto, about 2 m. deep, and from 1·2 m. to 1·6 m. in diameter.

All through winter, for several minutes every day, the paste or porridge in these vats is vigorously and thoroughly stirred. In the warm season, when the fermentation takes place more rapidly and the solid parts collect on the surface, it is only necessary to stir it from twice to four times daily. This is done with a sort of wooden shovel with a long handle, to work which the workman stands on the edge of the butt.

A common proverb says, the more rats have found their death in the butts, the better the Shôyû. This, though not to be taken literally, expresses the long time required for making Shôyû. This period varies, in fact, from twenty months to five years, beginning in autumn as a rule, after the Soja-bean harvest. In this slow and peculiar fermentation process a considerable proportion of starch is converted into dextrine and sugar, besides which lactic acid and acetic acid are formed. The paste, at first thick, becomes thinner and more fluid, while its grey hue gradually changes to a muddy brown, and at last to a pure dark-brown. This last and the agreeable aroma accompanying it, together with a bitter taste, are developed generally between the third and fifth year. The Shôyû which is most prized for its odour and taste is obtained only by mingling equal quantities of three-year and five-year product. The mixture is put into strong, coarse, close-woven bags of wool or hemp-linen, which have been rendered closer still by being dipped in Shibu (which see). These bags, 60 to 70 cm. long and 18 cm. wide, are filled loosely, and then laid lengthwise and crosswise on top of each other in a large square box. Then a heavy wooden cover is put on, and a simple lever-press applied,—one in which the long arm of 4 or 5 m. is weighted with stones. The expressed Shôyû flows through a hole in the bottom of the box into a bamboo cane, and through this to a cask sunk in the ground, and is then ready for use. As in oil refining, the first stuff produced is the most valuable. By continued pressure with increased weight a second quality is obtained, and at last a third, clear-flowing and less aromatic, as the dregs are mixed with salt-water and then squeezed again. Shôyû reaches the market in wooden barrels containing one To (20 liters). According to Hoffmann, the price was 1·5 yen (six shillings) for a To of the best sort, from three to four shillings for the second, and two shillings for the last.

The delightful aroma and pleasing taste of Shôyû are quickly lost in a long sea-voyage, through the formation of mould. In good condition, however, Shôyû proves an excellent means of sharpening the appetite and assisting digestion. It is on this account, as Chief Staff-surgeon Hoffmann justly remarks, much preferable to European preparations that are supposed to effect the same result, being perfectly harmless to the human system. In these appropriate words he notes the great part it plays in Japanese cooking :—

"Bean-sauce—Shoju—is almost as indispensable to the Japanese as rice, and its use is as general as that of tea and tobacco. The rich man and the beggar use it in the same way, merely with a difference in quality, as the chief relish to their meals, and it must be present in every house—indeed, at every meal."

7. Miso is a thick fluid, white or red sauce, easily divisible in water. Shiro-mame, or yellow-white Soja-beans, salt, and water bear a part in its production, and besides them Kôji, too, or fermenting rice. The proportions in which these substances are employed is not always the same, nor the means of applying them. The beans are usually left to swell for half a day in water, then boiled soft in a large kettle, and finally ground up to a paste. This paste is then mixed with common salt, Kôji, and water, and the resulting combination set aside in a cool place for a year or more. Miso does not spoil, and is said to be at its best when three years old. Its use is universal, especially in soup, but also in various other articles of food, in many respects resembling that of Shôyû. An analysis of Komaba gave 50·40 per cent. of water, 8·25 per cent. of fibre, 12·50 per cent. of ashes (salt), 0·61 per cent. of sugar, 10·80 per cent. of legumine, and 18·16 per cent. of soluble hydro-carbons.

8. Tôfu, called in English bean-curd, in German and French, less appropriately, *Bohnenkäse* and *fromage de pois*,[1] is a valuable article of food made in Japan and China from yellow Soja-beans. It consists of fresh coagulated legumine, so that the English term suits it better than the German. Its preparation is simple.

The yellow Soja-beans are put to soak, in cold water for from twelve to twenty-four hours, or a shorter time in warm, and then ground between the stones of a hand-mill, water being added to assist maceration. It becomes thus a thin mass, in which the quantity of water exceeds that of the beans about ten times. This is next filtered or pressed through a fine sieve, and the remnant put through the mill a second time. Ten volumes of this filtered stuff are now diluted with three volumes of hot water, and heated to boiling-point. This is done in a kettle, which is only about half filled. When cool again, the mass is filtered through a woollen sack, and the process ends with pressing it under the lever.

As in our soups from leguminous plants, the legumine is now found dissolved in the filtrate. To coagulate and separate it, there is added Shio-no-nigari (salt-bitter), *i.e.* brine from sea-salt, consisting principally of chloride of magnesium. Care is taken to have the precipitation take place slowly and quietly. (In China, according to St. Julien, burnt gypsum is also added.) When the liquor has cleared it is dipped out carefully, while the stuff precipitated is placed in four-cornered wooden forms with punctured, movable walls, which are lined with a cloth. This is folded together over

[1] See Ritter, "Mittheil. der deutsch. Ges. Ostasiens," 5 Heft, p. 4; and St. Julien, "Industries de l'Empire Chinois," Paris, 1869.

the Tôfu, a board is laid on top, and the Tôfu pressed out with a moderate weight of stones. Finally, the soft greyish mass is cut into tablets with broad latten knives, and put away under water. In summer this suffices only for a short time. To be kept longer, it is put up in Shôyû, or pickled, etc.

Kori-tôfu, frozen or ice-Tôfu, is the spongy, horn-like substance that remains when common Tôfu is allowed to freeze and then thawed and dried in the sun, thus getting rid of most of its water. By Yuba is meant a third preparation, consisting of brownish, tough skins, made by boiling the dissolved legumine of the Tôfu-process, with the addition of some wood-ashes, and then taking away in succession the scums that rise.

9. Undon, maccaroni, and Somen, vermicelli. As with us, they are made of flour, but they do not form an important article of the people's diet.

10. Fu is a remarkable product of the baker, which can hardly be called bread, being quite different in preparation and use. It is made from flour, which is treated much as in making vermicelli, though an inferior sort is used, a kind of wheat groats. Two parts of this are kneaded thoroughly with salt and water. The dough is then washed with water to cleanse it from bran and salt, and after the addition of two parts of Mochi-gome meal (cake-rice or glutinous rice), again kneaded vigorously. The result is an extraordinarily tough, elastic dough, which is repeatedly cut through and worked, so as to get rid of the water it contains. It is finally made into cylindrical forms two feet long, baked, and sold as Fu, cut up in small sheets. It is softened with warm water and cooked with other articles of food.

11. Sembei (pronounced Sémbé), an unleavened cake from the meal of glutinous rice or wheat, with the addition of sugar and other ingredients, and differing in taste accordingly, often recalls the unleavened Passover bread of the Jews in flavour and appearance. It is offered for sale, as a rule, in thin cakes, baked to a light-brown, or in the form of small rings. Those who sell these—mostly boys—go through the streets with the cry, "Sembei kawa-naika?" ("Won't you buy any Sémbé?") or "Sembei iri masenka?" ("Don't you want any Sémbé?")

12. Ame-no-mochi. According to an old well-known proverb, "there's no accounting for tastes." This is true also of the way in which the Japanese, to some extent, use the meal of wheat, buckwheat, and rice. While never exactly taking to our pastry, though given ample opportunity to become acquainted with it through the Portuguese and Dutch, they look upon certain unleavened and unbaked preparations of dough quite as delicacies, especially when filled with a mixture of bean-meal (Adzuki) and sugar. At the head of the list stand cakes from the elastic dough of the glutinous rice (Mochi-gome), particularly those called Ame-no-mochi. The small dough-cakes with this name, about the

shape and size of a fresh hand-cheese, merely from Mochi-gome meal or mixed with barley-meal or flour, and covered with honey (Hachi-midzu) or sugar, are offered for sale at different points along the old highways, the Tôkaidô, for example, and attention is especially called to them in the Japanese description of the road.

13. Satô, sugar, is obtained in the warmer provinces of Japan (Satsuma, Hizen, Tosa, Sanuki, Awa, Aki, Kii, Ise, Owai, Mikawa, Tôtômi, and Suruga), but especially in the Riu-kiu islands, from sugar-cane, Japanese Satô-kibi, *i.e.* sugar-millet. It is the so-called Chinese sugar-cane (*Saccharum sinense* Roxb.), a variety native to China, small but hardy, and able to resist low temperatures. It is raised to a small extent in the above-named provinces. Its vitality, however, is not great enough to enable it to withstand the frosts which even in Satsuma are not infrequent all the winter. Therefore the cultivation of sugar-cane is confined in Japan to the summer months. It is planted in the third or fourth month, and harvested in the ninth, having thus a period of only six months. It cannot blossom in so short a time, nor develop sugar as abundantly as canes of a greater age in more suitable climates. The cane which is used for planting is buried all the winter under earth and sand in a dry place, secure against cold. In the spring it is cut into pieces, which are planted as scions in the usual way. The process of sugar-making offers nothing worthy of note. It is not sufficient for the demand. Considerable quantities of raw sugar (white, yellow, dark-brown) have to be imported from Southern China (Swatau, Amoi, and Canton), but principally from Formosa. There is no refining.

14. Su, vinegar, is made chiefly from Sake. That from Mume-plums is more highly prized, and that from oranges still more so.

15. Kanten, or Tokoroten, in French *colle du Japon*, *gelatine végétale*, in English Japanese isinglass, is a preparation from various algæ, which we may designate *Algæ jellies*. It is largely exported from Japan to China, and of late to us also. It is used instead of gelatine, isinglass, and similar substances, both in housekeeping and in the trades, *e.g.* as a finish for woven goods. Before use, the Kanten-sô or Kanten-gusa (*i.e.* Kanten-plants) (*Gelidium coreum* Lamour.), and various other floridæ) are soaked and cleansed in fresh water, in which they swell up quickly into a gelatinous mass. But previously they are dried in the air, and put away dry until needed. Then they are boiled in a kettle with water, in which they easily and completely break up and dissolve. The sticky fluid is now squeezed through a hemp bag into a vessel, in which it coagulates to jelly upon cooling. This substance is now cut up, and the pieces are perfectly dried in the air on plaited bamboo or mats.

This algæ-jelly, which appears in commerce with the unsuitable English name isinglass, and is generally sold with us as Agar-Agar, appears as a rule in the form of irregular prismatic sticks, 3 cm.

in square cross measurement. Their length is 28 cm., their weight only 11 to 11·5 grm. It is a wrinkled, brittle substance, like a piece of membrane, without taste and smell, mostly of a light-yellow colour, in which case it is transparent, especially at its sharp edges; or blood-red, when it is more flaky and brittle. In cold water these sticks swell considerably, becoming spongy, four-sided prisms with concave sides, but not going quite to pieces. But if, when in this state, they are heated, even for a short time, they dissolve altogether. The solution coagulates anew when cooled, like glue, even when diluted.

An analysis of Kanten[1] gave 11·71 per cent. of albumen (?), 62·05 per cent. of non-nitrogenous matter (evidently glue, the pararabin of Reichardt), 3·44 per cent. of ashes, and 22·80 per cent. of water.

The Agar-Agar proper of the Malays, collected in large quantities at Singapore and in the whole Malay archipelago, and exported for the most part to China, consists of dried floridæ, near relatives of the *Gelidium corneum*, Lamx., and particularly of the varieties *Sphærococcus spinosus*, Ag., and *S. isiformis*.

3. Plants of Commerce.

(a) *Non-alcoholic Stimulants: Tea and Tobacco.*

Tea.

The trees and bushes of the Ternstroemiaceæ, belonging to the monsoon-region of South-Eastern Asia, are represented by two evergreens, the tea-plant and the camellia, which have won for this family distinction and significance all over the world. Both have been cultivated in China and Japan for many centuries on account of their leaves or blossoms. Tea-growing was till recently confined practically to these countries, and furnishes their second greatest article of commerce, its production keeping pace with a vastly increased consumption elsewhere; but the cultivation of the camellia has extended over nearly all the lands of Christendom, though mostly as a hothouse plant and under the gardener's care. This universal estimation and wide distribution of the camellia, moreover, are as much things of our century as is tea-drinking itself. And although they appeal to altogether different senses and tastes, the two plants have in their home a common use. This is the utilization of their close-grained wood, and especially of their oily seeds.

The relationship between these two plants, from an economic point of view, is seen in a still greater degree by observing more closely the entire structure of both, especially with regard to blos-

[1] In the Descriptive Catalogue of the International Health Exhibition, London, 1884.

TEA PLANT, CAMELLIA THEIFERA.

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soms and fruit, and is, in fact, so great, that the tea-plant has come lately to be looked upon by many as only a particular species of the genus camellia, since there are no generic differences (*e.g.* in Bentham and Hooper's "Genera Plantarum").

The history of the spread of tea-culture points, like the name itself in various languages, all back to China as the starting-point of the plant. In the greater part of the Chinese Empire, and particularly in Peking and Canton, the name of the leaves as prepared for the trade, and especially of the extract drawn from them by boiling water, is *cha* (tscha); and this is the name, too, in Japanese, Portuguese, and Russian (tschai). The words thea, Thee, thé, té, te, tea, etc., seem traceable to the province of Fukien, for, according to Williams ("The Middle Kingdom"), the plant is called tai in Amoy and ta in Futschau. But it is still doubtful whether China, the land where it has been longest cultivated, is its original home, and if so, which part of China. In 1826, as is well known, the tea-plant was found, growing wild apparently, in the jungle-forests of Assam; but the fact was not thoroughly understood till eight years later. *Thea Assamica*, Masters, like the camellia in Southern Japan, here reaches the size of real trees, 7 to 9 m. high, with light ash-coloured bark and large elliptical leaves, being widely differentiated through the latter from the bushy and small-leaved forms of the Chinese region of cultivation.

According to personal information furnished by Sir David Brandis, the Assam valley was thickly populated and in excellent cultivation even in the last century. This cultivation, however, was in great part destroyed by the incursions of the Burmese. At the present day the forests which have grown up over the ancient seats of civilization, contain the tea-tree, and it is probable, therefore, in spite of many peculiarities, that it has there only degenerated and become wild, and also possible that the tea-plant in a real state of nature is to be found in the primeval forests, still unexplored, of the neighbouring Indo-Chinese border-land.

According to recent opinions, however, the tea-tree of the Assam valley, like the various forms, checked in their development, of the cultivated shrub in China and Japan, belongs to the same species, which is called *Camellia theïfera*, Griffth., or *Thea chinensis*, Sims. According to this view, α *Thea viridis*, L., β *Thea Bohea*, L., γ *Thea assamica*, Masters, are all varieties in different degrees of transition.

Its general characteristics (see Table I.) are as follows: Bush or tree up to 9 m. high, with hard, light wood and many branches. Bark smooth, light ash-coloured, resembling that of beech, and brownish in young branches. Crown thick. Leaves persistent, short-stemmed, and from elliptical to narrow lanceolate; sharply serrated, with a bright, lasting, dark-green polish, but much thinner and less stiff and leathery than in the case of Camellia japonica; covered, when young, with a white down or silken hairs, which drop off in the course of development. Blossoms belonging, according to the Linnæan system, to Cl. 13, Order 1, almost odourless, regular, growing singly or in groups of two or three at the base of leaves, short-stemmed. Calyx with five or six leaves, corona regular, circular, 1 to 1½ cm. in diameter, white or pink, with six petals, of which the outer two are somewhat smaller than the four others. Anthers numerous, spread out in wheel-shape; style split in three; germ with three embryos. The fruit a round, three-chambered, three-seeded capsule, looking as if it consisted of three balls partly pressed into one another, growing to one side. The oily seeds, enclosed by a hard shell, are spherical, as large as a cherry-stone and the colour of hazel-nuts (*a*). Blossom-time and harvest are from September to December, so that the seeds require nearly a whole year to develop, and frosts, as a rule, destroy the later blossoms in the colder tea-districts of Japan, China, and the regions of the Himalayas.

Of the sub-species, *Thea viridis*, L., produces a quick-growing bush, which is hardier than *Th. Bohea*, L. Its leaves are lanceolate, and often reach a length from 8 to 12 cm., with a breadth one-third as great. They have coarse, irregularly indented edges, often somewhat undulating, thin, and of a light-green colour in hothouses. The blossoms, which are large, grow mostly singly.

Thea Bohea remains much smaller. (Though there are very large specimens of it, too, in the hothouses of botanical gardens; thus, for example, that of St. Petersburg, until within a few years, could show trees of *Thea viridis*, and also of *Thea Bohea*, which were about sixty years old and 5 m. high, with a stem-diameter of 12 to 15 cm.) It is more sensitive to cold. Its branches and twigs are stiff, like its leaves, which are of an elongated elliptical shape, scarcely half as long as those of *Thea viridis*, usually 3 to 5 cm. long, and half as broad, smooth, and regularly serrated. The bushes bloom luxuriantly, often having two or three blossoms at the base of each leaf.

Thea assamica Masters is, when cultivated, a beautiful little tree, 1½ m. high. Compared with the Chinese varieties its leaves are very large, elliptically pointed, 10 to 15 cm. long and half as broad, smooth, and strongly veined. A hybrid between the Assam plant and the Chinese tea-plant, which is now much grown in India, combines the richness in leaf-production and the strength in infusion of the Indian type with the compactness, hardiness, and pleasant aroma of the Chinese.

According to Fortune, Bohea is raised principally in the South of China, in the province of Kuang-tung, to make black tea; while *Thea viridis*, furnishes the green tea of the country south of the Yang-tse-kiang, and is shipped chiefly by way of Shanghai and Ningpo. To his amazement he found, however, that the so-called "Bohea Hills" of the great tea province Fukien, which yields black tea almost exclusively, were planted all over with *Thea viridis*, and soon became convinced that the colour of the tea of commerce is only the result of different ways of preparing the leaves, so that it depends merely on the process whether tea appears on the market as black or green. Almost all Japanese tea is green, though coming from several varieties of low-trimmed Bohea bushes. I have scarcely anywhere seen the form *Thea viridis*. Although Fortune, in his accounts of travel in China, broke down the erroneous but widespread idea that green and black tea were products of entirely distinct plants, *Thea viridis* and *Thea Bohea* respectively, he was by no means the first author to state the matter correctly. This had been done by Lettsom half a century before, on page 7 of his excellent work on the tea-plant,[1] in plain words, as follows:

"There is only one species of this plant, for the difference between green and Bohea tea depends on the nature of the soil, the cultivation, and the method of drying the leaves. It has even been observed that a green tea-tree, planted in the Bohea district, will yield Bohea tea, and likewise the contrary."

The principal tea-districts of India, China, and Japan begin at the tropic of Cancer (in Japan at 33° N.) and reach to the thirty-fifth parallel. In Japan the fortieth degree is the extreme northern limit of tea-plantations; in China, the thirty-sixth. In Java the tea-gardens have been laid out in the lower mountain zone, 1,000–1,200 m. above sea-level; in India they are in general 800–1,200 m. high, but in Assam and Chittagong only 60–80 m. In the lower temperature-belt for tea-culture, not only in Northern China and Japan, but also in the Himalayas, the bushes are often exposed to frosts in winter, which may be as severe as −9° C., without killing them. Climate, soil, and method of preparation, together with differences of character in the bushes, have, of course, the greatest influence on the quality of tea produced. As to soil, a moist sandy loam, on the lower slopes of hills, is the best bottom for a tea-plantation. Atmospheric water flows off easily from gently inclined ground of this sort, without carrying away good earth. There are no tea-gardens on the sides of steep mountains, and only exceptionally do we find terrace-culture for gardens of this sort. On the other hand, there are in Japan plantations on level plains, *e.g.* in the celebrated tea-district of Uji, on the Yodo-gawa, between Ôsaka and the Biwa Lake. In such a case, however, the ground must be well drained and the underground water kept away from the roots. Forest land, with damp, fertile soil on a bottom of sandy loam, has proved particularly favourable for raising the tea-plant in India and Java. Such soil is easily penetrated by its tap-roots, which find in it support and moisture. In China and Japan, where this virgin forest soil is seldom to be found, the ground is all the more carefully and deeply worked, well kept and manured, and these are essential elements in planting and tending a tea-garden.

[1] Lettsom: "The Natural History of the Tea-Tree," London, 1799.

The seed is sown either in autumn, immediately after harvest, or not until spring. In the latter case their reproductive power, which is easily lost, is best preserved by keeping them in a cool place, in a mixture of sand and other earth, as is done with cherry-stones and other seeds of stone-fruit. The garden is partly planted by seeds, and part by seedlings from the nursery, as can often be observed in Japan, where the nursery serves, too, as a welcome reserve from which to replace trees that have died, or to substitute one individual for another.

In direct sowing, rows 1–1·5 m. apart are dug in the ground, which has been well prepared and, in particular, manured and deeply worked. Through these rows, at equal distances, circles are drawn, 30–50 cm. in diameter. Each of these receives 20–30 seeds, distributed in such manner that in a few years, with proper pruning, there is formed from the plants a fine, dense bush, 40–120 cm. high, and almost half-spherical in shape. Covered with about 5 cm. of earth, the seeds planted in spring sprout in about fifty days. In the first summer the young plants reach a length of only 6–10 cm. In the second, they show their first side-shoots, and become about 25 cm. high. In three years they attain a height of about 50 cm. The nursery-raised sprouts are now transplanted, unless this was done in the spring after the second period of vegetation. In this case, the mode of procedure is similar to that already described, except that, as a rule, only ten to twelve plants are united for one bush, and the quincunx order common with us is maintained, so that single bushes in neighbouring rows may stand apart at the greatest possible interval.

The distance between rows and between individual bushes in rows, which are by no means the same in all plantatious, are usually in the following numerical proportions, the unit being a foot,—3 : 3; 3½ : 3; 4 : 3; 4 : 4; 5 : 4; 5 : 5. It has been discovered that production is greater when the plants are set close together, and certainly the ground is thus most easily kept clear of weeds; but, on the other hand, it is in this case very difficult to work the soil and manure it, and to gather the leaves. All requirements, however, are met when they are planted in the 4 : 4 or 4½ : 4 order, especially where, as in Japan, the bushes are kept low. They have free play in all directions, and for the roots too, which is just as important as air and light are for the health of the parts above ground.

Where the rows are set at a greater interval, leguminous plants, vegetables, tobacco, or even mulberry bushes are, in China and Japan, planted between them. On the way from Nara to Fushimi, in Japan, I observed rows of tea-trees at intervals of about 4 to 5 m. interchanged with rows of fruit-trees (*Diospyros Kaki*). The plantation, at some distance, reminded me of those in my own German home, where rows of berry-bushes alternate with cherry-trees. Mixed gardens of this sort are, however, exceptions; as a rule, the tea-garden, mostly lying free, serves no subordinate purpose.

In Japan, particularly in Kiushiu, tea-shrubs are not unfrequently found singly on the borders of terraces, fields, and roads, and sometimes even joined together as hedges. Such plants, however, yield only inferior products, and are not to be at all regarded as examples of a rational culture.

It is plain that E. Kaempfer—who did not become acquainted with those districts where tea culture is more extensively and carefully carried on—had such methods in view in Kiushiu, when he wrote that Tsja (Tscha) no ki, or the tea-tree, is given no other place but the borders of fields and similar spots inconvenient for use otherwise.[1] In like manner, and led astray in the same fashion, Maron remarks: "The tea-shrub is but little grown, and only in hedges and the borders of gardens, and I think it is scarcely anywhere cultivated in the open fields."[2]

In China the tea-gardens are mostly little spots of land, such as the peasant with his own family can work, though Fortune mentions some that embraced four or five acres. Plantations of this sort are not at all infrequent in Japan. It often happens that many of them lie contiguous, like the vineyards of different owners in Germany. Over softly swelling land, with a gentle rise, frequently by the side of yellow-green rice-fields, these tea-gardens present in summer an exceedingly pleasant aspect, with their foliage of dark green, especially if the picture is still further enlivened by women and children in their gay, clean clothes, busily picking the leaves.

The proper method of trimming the tea-shrub is one of the most important operations in tea-gardening, and calls for great skill and intelligence. For a pleasing appearance of the plantation is not the only object, but rather an increase in the amount and quality of crops. Like planting and manuring, this trimming must be done in the colder time of the year, just as in the cases of trees with us—a time when there is a cessation of growth, and the production of sap is at its least.

The tea-plantations are well manured, often four times a year, the strongest supply being given in spring, when the new epoch of vegetation begins. Oil-cakes and fish-guano are held particularly effective, and their use is preferred, especially for young plants. Where they cannot be had, and for older plants, recourse is had to human fæces. Since a year's crop of 1,600 lbs. of tea leaves per hectare deprives the soil of 100 kg. of nitrogen and 24 kg. of potash, etc., it is above all things necessary to replace this with an appropriate fertilizer. For this purpose wood-ashes and sea-algæ are the best, where they are to be obtained.

[1] E. Kaempfer: "Geschichte und Beschreibung von Japan," p. 131; and E. Kaempfer: "Amœn exot.," p. 612.

[2] Salviati: "Annalen der Landwirthschaft," 1869, p. 71.

The picking of the leaves begins in the third or fourth year of the plant's age, according as a garden is planted with seeds or with nursery-shoots. The crop increases up to the tenth or twelfth year if the trees are carefully tended and the weather is normal. Then there follows a gradual diminution, till, somewhere between the fifteenth and eighteenth years, a new laying out is necessary. But it often happens that a plantation is dead and the soil exhausted in ten or twelve years. On the other hand, one finds some which are at least twenty-five or thirty years old, and still productive, as for example in the celebrated tea district *Uji*, to which Kaempfer, even in his day, referred. "*Udsi tsjaa* nominavi; de qua ne quid in historia omittatur, pauca addimus *Udsi* oppidulum est ad limites maris situm (it is five miles north from the sea at Ôsaka), non procol a metropoli et Pontificali sede *Miaco*. . . . Ejus clima mira benignitate favet culturæ fruticus." The produce of this town of 2,400 inhabitants, however, owes its ancient reputation, less to an unusually favourable climate than to the peculiar handling and care of the tea-bushes at the time of the first growth of leaves, a fact I learned in Uji itself, and to which no one, to my knowledge, has yet called attention.

It is really two places, on each side of the Yodogawa, three-fourths of a mile above the town of Fushimi. That on the right bank belongs to Uji-gori, that on the left to Kuse-gori, both of them districts in the province of Yamashiro, of which the old capital, Kiôto (Miaco or Myako), is somewhat over one geographical mile distant.

The river emerges here from its narrow bed among the mountains and spreads over the plain which now begins. On the low hills of this transition-zone, and likewise in the plain itself, is raised the most valued tea of Uji, the choicest of which, to this day, costs ten yen—forty shillings—per kilo, as compared with two or three yen for the common sort.

About thirty days before the first harvest, which begins in the middle of May (the second commencing at the close of the rainy season, about two months later), the tea-gardens of Uji are roofed over. The roof rests on stakes and poles, and is composed of mats made from reeds laid closely side by side. It stands from one and a half to two meters above the ground—the bushes are from a half to one meter high—so that the people at work can walk about under it comfortably, and attend to the first crop of leaves. When this is over, the roof is taken down and put away in houses or sheds set apart for it, till the next year. It is said that it was in use more than two hundred years ago. Its object is to protect the bushes from the cold dew, which reddens the young leaves and gives them a bitter taste. It evidently diminishes the radiation of heat from ground and leaves, and thus the nocturnal cooling; the softened light, at the same time, lengthens the internodes of the young shoots and makes the leaves more tender. Both in

China and Japan, the leaves are plucked twice, as a rule. The first plucking, being the chief harvest, commences at the beginning or in the middle of May, according to the situation and advancement of the plantation (in Southern China it is earlier still), and lasts from ten to twenty days. The second is after the great summer rain, that is, from four to six weeks later. In many places in China the chief harvest is preceded by one in April, when undeveloped leaves are plucked, from which the white down has not yet departed, This yields the dearest sorts of tea—the finest Pekoe, Pekoe tips, incorrectly called Pekoe blossoms, and Young Hyson—and naturally demands especial care, so that neither the bushes may be injured, nor the chief harvest prejudiced. For the latter, full-grown, but still young, leaves are taken, fifteen pounds being plucked, on an average, by women and children; elsewhere, and even in Assam, three times that quantity is reckoned as the daily produce of an industrious man. Four pounds of fresh leaves are reckoned to one pound of prepared tea. The peasant who raised them either cures them himself, or sells them to a middle man. The second, or, as the case may be, third plucking of leaves, yields only older, coarser leaves, for home consumption or the production of brick tea. It is important that the fresh leaves should be worked up as quickly as possible, in order to obtain therefrom, according to the process, the green or black tea of commerce. The Chinese, according to the colour of the infusion, name the one sort Luh-cha, *i.e.* green tea, and the black, Hungcha, *i.e.* red tea. It has been discovered that when the leaves have withered for a long time they are easier to roll and otherwise manipulate, but that the extract suffers in colour and flavour. This is especially the case with green tea, whose quality is considerably advanced by rapid, skilful drying. Let us, then, first consider the preparation of green tea.

Japan, as already remarked, yields almost only green tea. The different processes through which the leaf passes, after being plucked, may be divided into those at the place of cultivation, and those at the wholesale merchant's before shipment.

a. The steaming of the leaves. A series of immured iron kettles (or pans) are half filled with water, which is brought to boiling by fires of charcoal beneath them. The mouth of each kettle is closed by a sieve, that fits tight into it. This is about 45 cm. in diameter, and on its bottom several handfuls (about a half-pound) of fresh tea-leaves are spread out. The sieve is closed above with a cover. For a short time, generally about half a minute, the steam is permitted to act upon the leaves, long enough to produce the characteristic odour of tea. The sieve with its contents is then taken off from the pans. The leaves are shaken together and then spread out over straw mats or tables. The damp leaves, of course, have lost their stiffness. They are soft and easily bent in all directions, showing everywhere traces of the oil which comes from them. Being spread out and fanned, they are quickly cooled, and then subjected to another operation, of especial importance, viz.,

b. Firing. A frame of wood or bamboo-cane is coated with cement, and serves as an oven or hearth. This frame is shaped like one of our country kneading-troughs, and is usually 120 cm. long by 75 cm. broad. On the floor of this hearth, surrounded with ashes, a gentle charcoal fire is kept up. A second frame—a hollow cover—shuts down over this vessel, like the tray of a trunk. The walls of this light tray are covered with heavy bast-paper; likewise its bottom, which only reaches to within 40–50 cm. of the glowing coals below, and is therefore not singed, the heat being not more than 50–60° C. Large producers have a number of these arrangements (3 to 8) in an airy apartment; for small producers a single one is often sufficient. Each is served by a strong man, almost naked. He pours into the tray about 800 me (nearly 3 kg.) of tea-leaves prepared as described in paragraph *a*, spreads them out over its paper bottom, and then stirs and works them continually with his hands. Next he lifts up the soft, moist leaves, and lets them fall again, till by-and-by they acquire a darker green colour. He now sets to work to rub and roll them between his palms into balls, which he again breaks up, and, by rolling up and down on the paper side-walls of the inner trough, forms anew and rotates with heavy pressure on the paper walls. Thus he keeps up the weary labour, with more or less variation, busily for several hours, until the entire mass has taken on a dark olive-green colour, and the separate leaves are curled and twisted and rolled. They are called squills by English tea-dealers. They are now spread out to dry on paper frames similarly warmed. Here they remain some time (4 to 12 hours) until quite brittle. The tea is now ready for home consumption, and only requires to be sorted and packed. In vessels of clay or porcelain, with close-fitting covers, it will keep at least a year.

c. Sorting the tea. Not a few young seed-capsules, besides leaves that were neither equal nor healthy, were plucked in harvesting. The capsules, on their short stems, look not unlike ordinary capers. In sorting, these, as well as stems and injurious leaves, are cast out. Further, the tea-dust which has been formed is separated from the leaves, which in turn are divided, the smaller from the larger, the object being to get a uniform, fine-looking article. To this end the dry tea is next winnowed with a light hand-sieve of bamboo, and the coarse stuff remaining, such as leaf-stems and seed-capsules, taken away. Hereupon follows the sifting of the tea. The sieve is suspended breast-high by a rope from the ceiling, so that it can be moved with ease in every direction, as well as in a circle. The finer stuff falls through on a pile, and there remain the more equally rolled and twisted leaves. Lastly, this tea, designed for exportation, is spread out on a table and carefully gone over again by girls, who pick out all remaining impurities—fruit-capsules, bits of stems, etc. All these processes being at length over, the product is packed in new wooden chests, each of which holds a half picul (30 kilo), and is sent to one of the treaty-ports for sale. Native middle-men attend to its transference from the producer's hands to those of the foreign merchant and exporter.

To render the tea fit for the sea-voyage and marketable, the exporter subjects it for one or two hours to another drying, and finally to colouring. With reference to the former, two methods are employed—pan firing and basket firing. Iron pans, more or less hemispherical, each 40 to 50 cm. across, and a little more than half as deep, are set in a row in low brick walls, in large, airy halls (tea-firing godowns). Each pan has its own little charcoal fire underneath. Many merchants have 500 persons, mostly women and girls, to serve the same number of pans, in one room. When the fresh tea is brought in from the country, it is lively enough here, from early morning till sunset, and the joking and nasal singing can be heard from afar. Upon a given signal from the Chinaman in charge, each pan, previously warmed, receives the contents of the basket which stands ready—about five pounds of tea. This is now, for the last time, industriously worked between the hands and kept in continual motion, till the overseer deems it perfectly dry. Colouring, in so far as it is still practised, comes next (of which more in detail below), and then the tea that is ready to be shipped is taken into the pack-room. Here it is packed while yet warm in so-called half-chests, each containing forty English pounds, and lined with sheets of lead. In this shape it reaches the dealers in the United States and the Dominion of Canada, these being the almost exclusive customers.

In basket-firing woven baskets of split bamboo are used, open at both ends. They are shaped like dice-boxes. The basket is tilted with one end over a pan in which are glowing coals surrounded by ashes. Into the other end is fitted a thick-meshed bamboo basket, round and flat, in which is strewn the tea which is to be heated. This method has only a limited application as compared with the other. These tea-drying establishments, and the processes gone through in them, certainly increase very considerably the price of export tea, but no plan has yet been discovered whereby the work could be done better and more cheaply.

The *Ten-cha* or *Hiki-cha*, or powder-tea, was named even by Kaempfer as the prime sort of Japanese tea. It is prepared from the most delicate leaves of older and very carefully tended bushes, in the same way as green tea, then put away with care, and ground before use with a hand-mill. It is the costliest sort, is not exported, and as a rule is served only on great occasions, *e.g.* the *Cha-no-yu*, or tea-parties.

Next in price to Hiki-cha comes *Giyokurô* or pearl tea, of which likewise little is exported.

Of the great mass of Japanese tea that finds its way out of the country, the better variety is called *Sen-cha* and the poorer *Ban-cha.* The latter is mostly the product of the second harvest. Of each of these two sorts of Japanese tea the annual product is now about fifteen million Japanese pounds, or nine million kilogrammes. According to the descriptions of Fortune, Williams, and others, the production of green tea in China differs in several respects from the Japanese method. The fresh leaves are not steamed, but heated for four or five minutes in flat iron pans over coal fires, with constant turning. The oil and water thus brought out make them soft and flexible. In this condition they are spread out on so-called rolling-tables. Each workman takes up as many as he can comfortably hold and manipulate. By pressing and rolling he forms a ball of them, which he works over and over, somewhat as a baker does his dough. Frequently, in this process, the ball goes from the hands of the first workman into those of a second and third. These open it, form it anew, press and roll it, and so it goes on till it reaches the head workman, who tests it and decides whether its leaves have been rolled enough. Although these operations last but a short time, they injure the hands of even the most skilful workmen severely, chiefly in consequence of the warmth of the tea-leaves and their juice. They diminish the volume of the leaves considerably—to about one-fourth of the original, and change yet more their shape and colour. These are thereupon spread out thinly in sieves of bamboo sticks, and slowly dried in the air. When the sky is overcast this takes several days. A second heating and manipulation of the air-dried leaves in the pans comes next, lasting about an hour. The leaves are constantly tossed about, first by hand, and then, when the heat increases, by a brush made from bamboo cane. In slipping down on the hot sloping back-wall of the pan, the leaves dry and roll up tight. Except sorting, the tea is now ready for home consumption. For the foreign market it is further manipulated, as described above, in the case of Japanese tea.

China exports most of its green tea from the northern tea-ports, Ningpo and Shanghai. It comes chiefly from the provinces directly south of the Yang-tse-kiang and west of Ningpo, from the hill-country of the provinces Chekiang, Ngan-hui, Kiangsi, and Hunan. It is customary to distinguish the sorts with the English terms, as *Imperial*, *Gunpowder*, *Young Hyson*, *Hyson*, and *Twankay.* The first two sorts also bear the name *pearl tea.* They are prepared from young, undeveloped leaves, and rolled in pellets, like the corresponding *caper*, which is included among the black sorts. According to Fortune, the caper is thus produced in Canton: "A parcel (20 to 30 pounds) of the tea as brought in from the country, and not yet fully prepared, was thrown into a heated drying-pan, then sprinkled with a bucketful of water, and quickly turned over. The leaves, of course, absorbed the water at once, and became thereby soft and pliable. They were now put in a strong canvas sack, which was twisted tight into a ball. This was thrown upon a mat, over which stretched a horizontal pole. A workman, holding fast to the pole with his hands, stepped on the mat in his bare feet, and turned the ball continually with his heels and toes and the soles of his feet. To preserve the spherical shape of the sack, with its diminishing volume, the man sprang aside every now and then, and twisted it tighter. In this way there came to be at last a much smaller but hard ball, and one no longer changing. This sack, with its contents, was thrown to one side, and left lying there several hours. When it was opened, and the leaves were taken out, they were found mostly rolled together in pellets. Quick drying in heated pans and sieves did the rest." (See representation on title-page of Fortune's "A Residence," etc.)

Twankay is the ordinary green tea that comes to Europe; Hyson the better sort. The word is said to be derived from Hi-chun, blossoming spring.

The production of *black tea*, or *Hung-cha* (*i.e.* red tea), as the Chinese call it, differs from the methods employed for green tea chiefly in the fact that the fresh-gathered leaves go through a kind of fermentation, to develop aroma and colour, before reaching the hot drying-pans. The character and quality of black tea depends in great measure upon this process of fermentation. Hence it is a matter of the greatest importance that it should be properly conducted. The fresh leaves are generally left over-night, or for several hours, on bamboo frames. They are then tossed up and gently beaten, till they are soft and pliable. These withered leaves are then piled up in a heap for several hours, where they become warm, moist, and dark. In this they may be compared with plants that are to be dried for a herbarium, which the botanist puts for some length of time in damp paper, and which become black, instead of green, as by the usual process. They remain wet in the air for some time—often two or three days, according to Fortune—and are then subjected to a strong heat in the pans. Thus their peculiar aroma and black—really brown—colour are developed, and also the reddish brown coloration of the infusion of the dry tea with boiling water. As to the remaining processes in the roasting-pan and elsewhere, there is no difference between the method for black tea and that for green already described.

Pekoe, *Souchong*, *Congo*, are the most noteworthy black teas of China, in the order of quality. To these must be added *Caper* and *Oolong*. I suppose the saying is in general correct, that, beginning with the tip of the young shoots, Pekoe is made from the end-buds and the first (youngest) leaf, Souchong from the two following, and Congo from the fourth, fifth, and sixth, that is, from the older leaves. Caper, as has already been remarked, is a fine black tea, of which the leaves are rolled into tight pellets by a particular method of handling, similar to that of green pearl-tea. Oolong is made in the province of Fukien, and used principally in India and Australia. It is a black variety, with the taste of green tea. The Congo,—that is, "well-worked,"—is also called *Bohea*, after a district in Fukien. It constitutes the great mass of cheaper black tea, and its poorest sort has been sold in London at threepence per pound. The common black tea of better quality is Souchong (*i.e.* small, rare sort), to which the *Caravan-tea* largely belongs. The Pekoe (Pek-ho, *i.e.* white down) is the finest and dearest black tea. The English expression Pekoe tips better characterizes the undeveloped leaflets of the buds, still covered with white down, than the term Pekoe-blossoms used by German merchants—a term against which Kaempfer, even in his day, argued in vain; for the tea-plant blossoms in autumn, and therefore long after the harvest, hence there cannot be blossoms in any variety of tea, least of all in Pekoe, which is picked first.

Souchong and Congo are blacker than Pekoe, and yield a darker liquid. It is, moreover, an established fact that the aroma is developed along with the leaves and does not appear until after their preparation. Very young leaves do not contain it. Hence the best Pekoe, despite its high price, cannot satisfy our taste, and must be mixed with Souchong. The better sorts of black tea, especially Souchong, were formerly the only kind exported as Caravan-tea. Being transported by land over cold, dry countries, they could dispense with the final thorough heating in the drying-establishments of the ports, and thus the aroma was better preserved; so that they were deservedly celebrated. But since more time has been devoted to preparing and packing tea for shipping, and this is so much more quickly accomplished, the difference in quality has largely disappeared, and there remains only the great difference in price, to the disadvantage of the Caravan-tea. As a consequence, the importation of cheap tea by ship into Russia is increasing steadily, while a falling off in that of Caravan-tea, across Siberia, has long been observed. A *Zuibik*, *i.e.* a cubical box, lined with lead, and painted on the outside and marked with Chinese characters, contains usually sixty pounds of Caravan-tea.

Black tea is produced chiefly in the provinces of Fukien, Kuang-tung, Hupeh, Hunan, and Sz'chuan, the last province also yielding a great deal of green tea and brick tea, for Tibet. Futscheufu and Canton are the principal ports for black tea, though Shanghai and Ningpo export great quantities of it too, besides green tea.

The preference of the Mongolians for green tea is shared only by North Americans and the upper classes in Morocco. By far the greater number of tea-drinkers in Europe prefer the black, and the foreign resident in Japan (even the tea-exporter) has it sent for his own use from China. The Japanese are well aware that they depend on the American taste for the sale of tea, their most important article of commerce, save one. For this reason their efforts to produce black tea, especially Congo (Kocha) and Oolong (Uriyo) have been multiplied in the last fifteen years, up to the present time, however, without satisfactory result. The black tea prepared in Japan, lacking the characteristic good taste and aroma and the strength, does not furnish an agreeable beverage. For reasons not yet fully learned, the Japanese tea-leaf cannot stand the process of fermentation so important in the production of the black sorts of Chinese tea. It becomes easily damp and limp after this process, yielding an unpleasant smell instead of the prized aroma.

When the chief harvest in Japan is past, the older leaves are gathered for home consumption, and preparations are made from them. These vary according to the method of drying, and are known as Hiboshi, Kamairi, and Kuroguchi. The infusion they yield is of a dark colour, as with Congo, and has a taste that is not agreeable to us.

Colouring and Scenting the Tea.

Two more processes are here to be considered, which are designed to satisfy singular preferences of Western consumers, preferences that are incomprehensible to the Mongolian. These processes are colouring and scenting.

Colouring is applied to green tea only. The exporter in Japan and China adds to every pan of tea, especially such as is designed for the North American market, towards the close of the last firing, a little bit of powder—as much as will lie on a knife's point. This powder is a mixture of Prussian blue and Chinese soap-stone, or gypsum,—in Japan nearly always the latter,—generally in the proportion of four to one. This blue powder is readily absorbed by the moist, warm tea. It increases its weight only about 1¼ per cent., and is not at all injurious to the consumer's health. But it serves no rational end, since its only result is to change and heighten somewhat the natural, though less pronounced green of the leaves, to meet what has been hitherto the taste in North America.

Scenting of tea is done only in China, and chiefly in the case of the better black sorts. Like colouring, it seems to be on the decline. They use the odorous blossoms, separated from their stems and calyxes, of *Jasminum Sambac*, Ait., *Jasm. paniculatum*, Lour., *Citrus Bigaradia*, Duham., *Rosa centifolia*, L., *Prunus Mume*, S. and Z., *Olea fragrans*, Thunb., *Aglaia odorata*, Lour., *Gardenia florida*, L., and *Daphne odora*, Thunb. When the tea is otherwise ready, it is mixed with these blossoms (*e.g.*, one hundred pounds of tea with forty pounds of orange-blossoms, or blossoms of the Jasmin, with one hundred pounds of blossoms of the Aglaia odorata). They are allowed to remain in contact for twenty-four hours. Then the blossoms and fragments of blossoms are separated out by sifting, fanning, and picking. The tea has taken from them moisture and aroma, both of which are got rid of again by a quick heating. The odour, "the bouquet," of the tea remains, however, from one to six years, according to quality and strength, if it is carefully packed. Scented tea was formerly prepared only in Canton, but now also in the northern ports, as Shanghai and Ningpo. The traveller who sails towards these cities in early summer in a coaster from the south finds himself sometimes accompanied by hundreds of pots filled with blooming bushes of several of the above-named species, which are sent north for this purpose from Canton, Macao, and Hong-kong.

Under the names "Orange Pekoe," "Scented Caper," etc., this perfumed tea comes, carefully packed, to London, Rotterdam, and other ports, and is here further mingled with tea that has not such "bouquet." (For further details see Fortune's "A Residence among the Chinese," p. 199 ff. London, 1857.) Good tea must, however, have its own aroma. The addition of a foreign one is, in my opinion, altogether to be condemned. The volatile oil which the tea receives in being scented is just as likely to have an injurious effect upon delicate nerves, and produce headache, as in wine and punch essences.

The property of the green or brownish red extract, which is produced by pouring boiling water on the tea of commerce, to warm, refresh, and invigorate the body, has been highly valued for many centuries by the Mongolian races. Among the civilized nations of the West tea only found entrance two hundred years ago, and very slowly at first. But in this century its introduction and distribution have been all the quicker. In many households it has already completely driven its competitors, coffee and cocoa, from the field. In the Orient it meets with no competition at all, being equally popular with high and low.

The Japanese, like the Chinese, seldom drinks cold water. Tea is his favourite beverage at every meal and between meals—green tea, from little pots on little saucers to correspond. He drinks it plain, and when it is not to be had does not despise mere warm water from the iron kettle, which always serves otherwise to fill up the tea-pot. No sooner has the traveller in Japan sat down in an inn, than, without delay, a basin with some glowing coals is set before him to light his pipe with, and tea to refresh him. This attention he rewards with the Cha-dai (*i.e.* tea-table), or tip, which he lays on the salver. When a customer enters one of the larger shops, it is a point of etiquette in the house that a cup of green tea be set before him at once, before proceeding to business.

In the poor mountain country, however, the quality of the drink offered under the name of Tscha is not always so inviting—an infusion or decoction from the cheapest waste matter of the tea-districts, looking like dish-water and just as little appetizing.

Brick-tea (*Chin. Tung-kau, Russ. Kirpitschnoi-tschai*).

As has been remarked, black and green tea furnish the healthiest and most important stimulant for a large part of the human race. Apart from this chief use of the leaves of the tea-tree, however, we have now to consider another, no less significant for a further portion of human society, namely, as an actual means of nourishment, for as such we must regard the so-called brick-tea. Its preparation, in Sz'chuan, Hupeh, and neighbouring Chinese provinces, takes place after harvest and the operations thereupon following in preparing common tea. For this purpose the remnants and the older leaves are exposed for some considerable time to steam, to be softened. Then they are pressed in tablets, in the form of thin bricks, namely, 8–12 inches (20–30 cm.) long and broad, and one inch (2½ cm.) thick, and kept under pressure till dry and hard. Mongolians and the inhabitants of Tibet are the principal consumers, to whom must be added several Russian races. For use, a piece is knocked off, boiled with milk or water, seasoned with butter, a little vinegar, pepper, and salt, and eaten as soup. This is said not to be a very inviting dish in appearance, but refreshing and nourishing, as may be supposed, since it contains not only the essences of tea, but also the coagulating albumen and the cellular substance.

We cannot tell exactly when the cultivation of tea began in China. According to W. Williams, the oldest Chinese records of tea go back only to the year 350 A.D. An Arabian merchant, named Soliman, who published, about 850 A.D., an account of his travels in Eastern Asia, remarks that tea was the common drink of the Chinese. Strange to say, Marco Polo makes no mention of it. This may perhaps be explained by supposing that up to the end of the 13th century the knowledge of its use had not travelled from the Chinese of the South northward to the Mongolian-Tartar peoples among whom the celebrated Venetian lived. Certain it is that Europe received its first knowledge of tea through Jesuit missionaries in the second half of the sixteenth century. At that time the Jesuits in great numbers lived and laboured successfully among the people in China and Japan.[1] But the first specimens of the article did not come to Europe till much later (1610 A.D.), and then not through the Jesuits, as might be supposed, but through the Dutch East India Company, and probably from Japan. In 1664 the English East India Company brought two pounds and two ounces of black tea from the province of Fukien, as a present to King Charles II.; but not until fourteen years later (1678) did it deem it advisable to admit tea into its list as a new article of commerce. In that year it began exporting it to England, with 4,713 pounds as a beginning. It held a monopoly of the English trade up to 1834, when the importation into Great Britain and Ireland had increased to 30½ million pounds.

[1] See J. P. Maffeus: "Rerum Indicarum," libro ii. p. 108 ff.

When the tea-trade was thrown open in England, with the reduction in cost of transportation and of entrance duty, and with the addition of new producers (India and Java), the prices of tea sank more and more,[1] and its consumption increased accordingly. Tea ceased to be a mere luxury on the tables of the well-to-do. Millions of poor people in Europe and in all English-speaking countries have become accustomed to its enjoyment, and found that it furnishes them the cheapest and healthiest warm drink. The way its use is distributed over the different countries, is seen in one of the following summary tables.

According to Junker von Langegg,[2] tea has been known in Japan for more than a thousand years, but has become the national beverage only since the fourteenth century. In the eighth century of our era the imperial court (Shomu Tennô, Kwanmu Tennô) first became acquainted with it. Towards the end of the latter emperor's reign, the priest Saitô (Denkio Daishi) introduced tea-seeds from China and planted them at Uji (805 A.D.). According to another authority, tea-seeds and the art of preparing tea were, previous to this, brought from China, by the abbot Yei-shu, to his monastery in Omi, and cultivated there. In agreement with this we have the further statement that Saga Tennô, the fifty-second emperor, visiting this monastery in 815, was regaled with tea, and that the drink having met his approbation, he issued a mandate for the establishment of tea-gardens in the neighbouring provinces of the Gokinai, and also in Omi, Tamba, and Harima.

At that time, and even centuries later, tea was very dear, a luxury of which only the nobility and the Bonzes partook. The cultivation of the tea-plant seems to have gradually fallen into neglect, for only on this supposition is there significance in another story,—that the Bonze Yei-sei, about the year 1200, introduced the plant into the province of Chikuzen, on the island of Kiushiu, by means of seeds from China, and that anyhow it was not until this time, under the patronage of the eighty-third emperor (Tsuchi Mikado Tennô) that tea-growing secured a firm hold in Japan. Miyo-ye (Meiki), abbot of the monastery Togano, near Kiôto, received tea-seeds from Yei-sei, with directions for training the shrub and treating the leaves. He is considered the founder of tea-culture in Yamashiro and Yamato, and particularly at *Uji*, the celebrated place for tea. To this day in a chapel there the first tea is offered to him every year. Further advancement of tea-growing around Uji was caused by Shôgun Ashikaga Yoshimitsu after his abdication, about the year 1400. We have already cited some of Kaempfer's remarks about the tea of Uji, and seen therefrom that its fame was already great throughout Japan two hundred years

[1] For a long time a pound had cost from £10 to £5 in London, and even in 1780 it was sold at £3.

[2] "Japanische Theegeschichten." Vienna, 1884, C. Gerold.

ago. In another passage of the "Amœnitates exoticæ" the author states that the best Uji tea was reserved for the court, and that he had been told that a little dish of it, set before him, was worth one Bu (about a shilling). I bought a pound of tea in Uji, which I had followed in the making, and it cost me three yen. I heard, however, that the finest is sold for five yen,—twenty shillings.

The court had its special official in Uji, who had to superintend most carefully the ceremonial and the regulations for the preparation of its tea as well as its transportation.

So long as the Portuguese had the Japanese trade in their hands, tea was scarcely thought of, and even in the long period when Holland alone enjoyed commercial relations with Japan, tea did not figure among that country's exports. It did not begin to do so until the ports were opened in consequence of the Perry expedition. The appended table shows to what extent the exportation of tea from Japan has grown since then. As exportation increased, the plant was more extensively grown, so that on my journeys I could see new gardens laid out in hundreds of places where tea had never been before cultivated. In Tôkio itself, as is well known to any one who has lived there any time, many a piece of ground has been transformed, even from the former parks of Daimio residences, into tea-gardens. The Japanese government has reckoned that in this way altogether 4,600 chô of land have in recent times been withdrawn from cultivation for other crops and devoted to raising tea.

According to H. Gribble, whose statistical statements I here follow, Japan possessed 42,224 chô = 41,874 ha, in tea-plantations, in the year 1881. Thus they at present embrace at least 42,000 ha, or about $2\frac{1}{3}$ per cent. of all the cultivated land. Tea is grown in nearly all the provinces of Japan south of the Tsugaru Strait, though in widely varying quantities. North of the thirty-seventh parallel and in the high-lying provinces of the interior, as Shinano and Hida, it is confined to a few favourable spots. In other parts it is the chief source of wealth. In both the quality and the quantity of their product the provinces of central Hondo take the lead. Two mighty wings have grown from the old centre of tea-culture, at the southern end of Biwa Lake, between the bays of Idzumi, Owari, and Wakasa, to which are to be reckoned the provinces of Yamashiro, Yamato, Ise, Iga, Omi, Mino, and Tamba. One of these, beginning with Ise, embraces the provinces of the Tôkaidô, particularly Mikawa, Tôtômi, Suruga, Musashi, Shimosa, and Hitachi. The other reaches over those of the Hokurokudô, among which Kaga and Echigo deserve especial attention. It is precisely in the region of these two highway-districts (the Tôkaidô and Hokurokudô) that tea-culture has been greatly extended during the last twenty years. It would undoubtedly have spread still further in the provinces of the Sea of Japan, especially in Echizen and Wakasa, if market facilities were more favourable here and the product could be shipped directly from the port of Tsuruga.

From the above we perceive that the chief tea-district of Japan lies in the island of Hondo, between 34° and 36° N. Lat. Tea raised at a distance from these boundaries is of poorer quality and of a lower price.

This is particularly true of all tea shipped from Nagasáki, and Niigata to Yokohama. In the former case the cause is the careless treatment of the tea-plant, in the latter it is climatic. The tea sent from Niigata comes from the districts of Murakami, Muramachi, Kurokawa, and Niidzu, that is to say from the northernmost parts of the province of Echigo. The tea-plant is kept trimmed very low there and carefully cultivated, yet it is impossible to give it adequate protection against the effects of a long winter and the night frosts in April, despite the covering of straw and snow during the former. Its leaf is consequently tough and bitter.

The above mentioned regions are, at any rate, the most northerly in which tea-bushes can be profitably and largely planted. In Akita-ken, under the fortieth parallel, where I saw the last tea-gardens, they can be maintained only by special protection in winter. My observations led me to believe that successful tea-culture ends with the wild-growing camellia, in 38½° N. Lat., in northern Echigo.

Much can be learned from the table in the appendix. First we observe that the provinces of Suruga, Mino, Tôtômi, Ise, Musashi, Shimosa, Yamashiro, Omi, Hitachi, and Yamato stand in advance of all the others in the area devoted to tea-culture, and Suruga alone has more than one-eighth of all tea-gardens in Japan. In these ten provinces tea-gardens take up 0·7 per cent. of the area, in Suruga 1·5 per cent. There is no doubt that the extensive tea-culture of Suruga is due in part to the great protection afforded by Fuji-san and other high mountains against the rude north winds.

Of the total area in 1881 given up to tea-culture, 42,224 chô or 41,874 ha, the proportion was as follows :

	kin.
Tencha or Hikicha, *i.e.* pulverized tea	36,668
Giyoku-rô or dewdrops	167,728
Sencha or common tea	14,797,945
Bancha or ordinary tea	14,294,895
Hiboshi or tea dried in the sun Kamairi or tea heated in the pan Kuroguchi or badly heated tea	4,940,277
Kocha or Congo	450,124
Uriyo or Oolong	319,604
Total kin	35,007,241

or 21,040,724 kilo. This makes 480 kilo per ha.

In general four pounds of fresh tea-leaves yield one pound of the finished article of commerce. The leaf-crop of a Japanese tea-garden of one ha would therefore amount to 1,920 kg.

Tea culture in India has been developed since the year 1835, at first but slowly, but afterwards the more rapidly during the last twenty years. After the first experiments, the Assam Tea Company was founded, in 1839. From 1864 to 1876 the crop increased from 2½ million pounds to 28 million pounds of prepared tea. In the last-named year the average price in London for one pound of Indian tea was 1*s.* 11*d.* as against 1*s.* 3*d.* for one pound of Chinese tea. In the year 1879 the area devoted to tea-plants in India was reckoned at 206,874 acres, which yielded a total of 44,771,632 pounds of tea. Of this 41½ million pounds were shipped to Europe. It is evident from these data that an acre yields on an average 216 pounds of tea, which is 245 kg. to a hectare. This amount is so far behind that ascribed to Japan (480 kg. per ha) that one cannot help doubting the correctness of one or other of the reports upon which the calculation is based. The Indian tea-industry has spread from the Assam valley over Chittagong and Arracan, Darjeeling, Nagpore, Kangra, and other regions, and gains ground every year.

Tea culture in Java, although beginning in 1828, seven years before that of India, has had no such rapid growth. Java tea has, certainly, a good appearance and is nicely rolled, but its decoction is weak and tastes bitter. Its price is therefore far less than that of the Indian and even of the Chinese, and indeed to this circumstance is attributable the fact that the industry has not become as widespread in Java as was expected. The exportation of tea from Java was 3,104,000 kg. in 1872.

During the last fifty years, as has been shown, the cultivation of the tea-plant has extended over two new countries (India and Java), while ever spreading, with increasing exportation, in its old homes, China and Japan. But it remained, for all that, till lately confined to the monsoon-region. Now, the Colony of Natal must be added as another part of the globe in which tea has been successfully tried and forms already an article of export.

However, we find, in the monsoon-region as nowhere else, the two fundamental conditions of its success,—a proper climate and plenty of cheap labour. Machines can never quite take the place of hand labour in picking, preparing, and sorting tea. Throughout the monsoon-region the cost of hand labour is so low, and that of tea in proportion, that it would be hard for other civilized countries to compete with it.

The climatic requirements of tea-growing, too, can only here and there be met elsewhere. The tea-plant flourishes best and yields the most valuable leaves where the temperature ranges between 0° and 35° C., where the humidity of the atmosphere during the period of vegetation is considerable, and rainfalls rather frequent.

Its needs in this respect are quite different from those of the grape-vine, to which dry heat is especially advantageous, so that a successful cultivation of the one excludes the other, so to speak.

A.—Table of the areas devoted to tea-growing in Japan, in 1881.

Province.	Chô.	Province.	Chô.
Suruga	5355·5		32102·9
Mino	4069·3	Hizen	721·1
Tôtômi	3541·2	Iga	679·7
Ise	3300·8	Kaga	655·2
Musashi	2830·2	Iyo	564·0
Shimosa	2354·8	Etchiu	513·9
Yamashiro	2260·5	Buzen	464·6
Omi	1555·0	Awa	428·5
Hitachi	1388·9	Kii	395·2
Yamato	1040·2	Mikawa	389·3
Higo	930·7	Chikugo	348·3
Tosa	961·7	Ôsumi	333·7
Hiuga	867·1	Kawachi	308·0
Echigo	849·8	The rest of the country	4320·0
Tamba	797·2		
	32102·9	Total.	42224·4
		or 41174 Ha.	

B.—Analyses of Tea.

By A. W. Blythe :

	Water.	Theïne.	Extract.	Gum.	Ashes.	Soluble Ashes.	Potash.	Gelatinous Silica.
Hyson	6·61	1·60	36·95	7·25	6·85	3·37	1·53	0·52
Japan	4·69	1·38	39·41	10·29	6·56	3·21	1·41	0·79

Green Chinese Tea according to Hassall :

Nitrog. Matter.	Water.	Theïne.	Chlorophyll and Fat.	Gum.	Tannin.	Fibre.	Ashes.
24·39	9·37	2·79	1·83	5·89	18·69	31·66	5·38

Stonehouse according to the "Annalen der Chemie u. Pharmacie," vol. 45, p. 336, found the proportion of theïne as follows :

Huasan.	Congo.	Black Assam.	Green Twankay.
1·09	1·02	1·37	0·98

2. *Tobacco, Nicotiana Tabacum, L., and N. rustica, L.*

The foreign origin of this world-wide narcotic article of luxury is indicated not merely by the name Tabako,—the Japanese have no name of their own for it,—but also by authentic historical accounts of its introduction. Like Christianity, gunpowder, and fire-arms, tobacco first reached Japan through the "Nanban" (pronounced Námban) or "southern barbarians." By "Namban," however, were meant distinctively the Portuguese, and then later the Spaniards who came from Manila. One may say that smoking was introduced in the last decades of the sixteenth century. The planting of tobacco, however, began about the year 1605. A physician named Saka, of Nagasáki, made some interesting and characteristic observations about it in a family chronicle of that period.[1] In 1607 he writes: "Of late a thing has come into fashion, called tobacco. It is said to have originated in Nanban, and consists of large leaves, which are cut up, and of which one drinks the smoke." Two years later the same observer remarks: "For the last two or three years an article called Tabako has been coming from Nanban, with which all classes of Japanese regale themselves. It is said to be a cure for all diseases. On the other hand, however, there have been cases where people got sick after they had drunk tobacco-smoke. Now since no medicinal work contains directions for the treatment of such patients, no medicine could be offered them." In another record, of the year 1605, according to Satow, there is found the following note: "In this year tobacco was brought in ships of the Nanban-people, and sown near Nagasáki. The inhabitants of the capital (Kiôto) contend with one another in smoking, and the habit is rapidly spreading over the country."[2] We may be sure that the innovation, before it got to Nagasáki, was known in Bungo, the chief foothold of the Portuguese from the beginning, and in Satsuma, which to this day has a great reputation throughout Japan for its tobacco, and had been visited by Pinto and likewise by Xavier. And there can be scarcely any doubt that smoking came to the Coreans and the neighbouring Mandschu from Japan, at the time of Hideyoshi, through the expedition and subsequent efforts between the years 1592 and 1597. On the other hand, China proper was blessed with tobacco *viâ* Luzon, as can be proved from several sources, among them Satow.

In China, as in Japan, smoking spread among all classes of the people and in both sexes, with incredible rapidity. As vain as the efforts of Pope Urban VII. and James I., to check the habit in

[1] See *Satow:* "The Introduction of Tobacco into Japan," *Japan Weekly Mail*, Nov. 17, 1877. Rein: "Zur Geschichte der Verbreitung des Tabaks und Mais in Ostasien." Peterm., Mitth., 1878.

[2] We here expressly remark that other narcotic luxuries, such as smoking opium or hemp and chewing betel, are unknown.

Europe, were the decrees of their mighty contemporaries, of the Ming-dynasty in China and Iyeyasu in Japan. Indeed, of all the laws of the founder of the Tokugawa rule, probably none has proved so ineffectual as the edict of 1612 against smoking and planting tobacco.

The *Kiseru*, the Japanese pipe, with its shining metal mouthpiece and the elegant little bowl of brass or silver at its other end—the stem is of thin bamboo—is quite a different apparatus from our smoking implement, and demands a different kind of treatment. The little ball of fine-cut tobacco with which its possessor fills the bowl, which in shape and size resembles the cup of a large acorn, suffices for only two or three whiffs. Then the bowl must be knocked against the edge of an ash-basin and filled anew. The case and tobacco-pouch, of stamped leather-paper, are as delicately made as the little pipe itself, and often artistically decorated with lacquer or silver-work, as shown in the illustration. Both are hung to the girdle-cloth by means of a *netzuke* (of which an account is given under art-industries), a sort of carved button. The form of such a pipe, which, with tobacco, every one carries in Japan, does not permit of smoking on the road nor at work. On the other hand no opportunity before or after is wasted ; out comes the pipe and at least a couple of whiffs are taken, a good deal of time being often spent with it. When any one enters a house, the first attention shown him by the female servants, after the customary greeting, is to set the tobacco-tray (Tabako-bon) before him, even before offering him tea. Upon this tray stands, however, the Hi-ire or fire-pot, with glowing coals, and a big ash-basin (Hai-fuki) of bamboo-cane, which serves also as a spittoon.

The Japanese tobacco-pipe resembles the shell of a snail of the genus Clausilia, which is represented by many forms in that country. This has not escaped the attention of the Japanese, who call them *kiseru-gai*, pipe-snails. In his book, "Himalayan Journals," Table III. fig. 7, Hooker gives an illustration of a Thibetan tobacco pipe, very similar to the Japanese Kiseru.

Tobacco-smoking is much more common in Japan than with us, and I always caused astonishment by the phrase I used so much, "Arigato, tobako-o nomimasen," ("Thank you, I don't drink tobacco"), for they can hardly imagine a foreigner who does not like tobacco. The Japanese says, not incorrectly, "Tabako-o nomimas," "I drink tobacco," since he sips in the smoke and expels it through his nose. In Germany too it was called at first "drinking tobacco," instead of smoking, as, among others, Freytag teaches us in his "Bilder aus der deutschen Vergangenheit."

On the paper-lined screen that divides a Japanese tobacco shop from the street, a tobacco-leaf is painted instead of a sign, and beside this stand two Chinese hieroglyphics which in other cases might perhaps be translated "chief town of the country," but which mean in this case *Kokubu*, a district of Ôsumi in southern Kiushiu, celebrated for its tobacco. Its name has been everywhere applied to the tobacco business.

I visited the district of Kokubu in the spring of 1875. It comprises a small plain on the north-eastern shore of the Kagoshima

Fig. 1. KISERU—THE JAPANESE PIPE.

Bay. Its light soil, mixed with much pumiceous sand, yields fairly good harvests only when very carefully manured and worked. The seed-bed of the tobacco is protected against too great cooling from radiation on spring nights by straw roofs about a meter high.

Towards the end of April the shoots are strong enough to be transplanted into rows, as elsewhere. They are set out beside rows of barley, which has by this time passed its bloom. Elsewhere, for instance in Higo, tobacco-sowing does not take place till April, but transplanting is in June, to barley or wheat fields which are not intended to receive rice.

Tobacco-growing is widely, though very unequally, spread throughout the Japanese islands. The first picking takes place in August, with a second and third in September. The leaves are then hung about the houses to dry, as with us. I saw the following arrangement employed for this purpose in Aidzu : one person was twisting two thin straw ropes into a thicker one, another meanwhile inserting tobacco leaves in pairs, with their stems all turned up at intervals of about 10 cm. When fixed in this way the rope was hung up on the walls of the building or on poles, with numerous leaves pointing downward.

Of all the varieties of Japanese tobacco that from the former dominion of Satsuma, to which Kokubu also belongs, as we have said already, has the greatest reputation among the natives. Its flavour is too sweet for Europeans, however, and it is therefore but little exported. The kind most valued for export, though it too is far inferior to American tobacco, comes from Higo and other provinces of the south. It is sent to Nagasáki packed in straw mats. Here it is stemmed and repacked in bales. These go exclusively to England. The leaf has a spongy character ; it is therefore mixed with stronger sorts, with the result that it absorbs a considerable amount of the sharpness. As an article of exportation, tobacco ranks far behind many other products, and is in general not much in demand.

b. *Drugs.*

In the diary of my first journey in Japan, in the summer of 1874, there is this entry, at the town of Sunjo, at the foot of Ibukiyama (See Rein, "Japan," vol. i. p. 77) :—"My host told me that Ibukiyama abounded in herbs, yielding 130 different medicines, mostly vegetable. From his little collection he presented me with two included in that number, the one a piece of stalactite, the other a piece of fibrous wollastonite." The Chinese science of pharmacy, which the Japanese followed blindly till thirty years ago, like our own in the Middle Ages and even later, up to the development of chemistry, enumerates a very large number of drugs, some of which are exceedingly rare. Thunberg brought a small list of Japanese plants used for pharmaceutical purposes, and v. Siebold in the work already cited, "Verhandl. van het Batav. Genootschap, xii. deel. Bat. 1830," furnished a long, but by no means exhaustive, catalogue. Oyaku-yen (the Garden of Physic), which was established by the Tokugawa in Yedo, two hundred years ago, the Botanical Garden of the Tôkio of to-day, contains the most important of them.[1] It is not within the scope and purpose of this work to repeat or enlarge it. I shall confine myself rather to the relatively few plants which I found cultivated for medicinal purposes, and in regard to which I know, from my own observation, that they are still of more or less importance in husbandry.

(1) *Pæonia Moutan*, Sims, Jap. Botan.

(2) *Pæonia albiflora*, Pall., Jap. Shakuyaku.

The ancients more than two thousand years ago, celebrated the healing power of *Pæonia officinalis*, L., which is indigenous in the mountains of Greece and other Mediterranean countries, and named it after Pæon, the chief physician of the gods. Both of those kinds of shrub-shaped peonies enjoy an equally long standing renown among the Chinese and Japanese. They are often raised, not only for their handsome flowers, but for their medicinal roots. (See also decoration, in "Art Industry.") One sometimes finds a third and larger shrub set beside them in a garden plot, which, too, serves medicinal purposes, namely:—

(3) *Evodia rutæcarpa*, Benth., Jap. Goshiu-yu or Kawa-haji-kami. It resembles sumach, with its pinnate leaves, and is valued chiefly for its aromatic berries,—like its relatives, *Evodia glauca* and *Xanthoxylum piperitum*.

(4) *Ricinus communis*, L., Jap. Himashi. This is also called Tôjin-mame (Chinese bean) and Tô-goma (Chinese sesame), names which speak for its introduction from China. Often enough one meets with little plantations of various medicinal herbs side by side. In this wise I have found growing in the open field:—

(5) *Fœniculum vulgare*, Gaertn., the fennel, Jap. Uikiyo.

(6) *Angelica refracta*, Fr. Schmidt., Jap. Senkiyu.

(7) *Angelica anomala*, Lall., Jap. Biyakushi.

(8) *Scutellaria macrantha*, Fisch., Jap. Ogon.

(9) *Mentha piperita*, Thunb., peppermint, Jap. Hak'ka.

(10) *Rheum palmatum*, L., Jap. Daiô.

(11) *Rheum undulatum*, L., Jap. Daiô. We know now the real home of this rhubarb through Przewalski's account of his journey to the Kuku-noor and the head-waters of the Hoang-ho. According to him the centre of its natural distribution is the mountain country between the sources of the Hoang-ho, Yalung, and Minkiang, in China.

In connection with the foregoing drugs, I would mention, on account of their peculiar and well-known use, three, that grow wild in Japan:—

(12) *Aconitum Fischeri*, Reichb., Jap. Tori-kabuto.

(13) *Artemisia vulgaris*, L., Jap. Yomogi (Mogusa).

(14) *Illicium*, S. and Z., Jap. Sikimi (pronounced Skimi.)

[1] In the tenth volume of the *Pharmaceutical Journal*, Holmes has recently annotated a large number of them.

The first of these three plants, the light-blue monk's-hood, which is found in mountain forests all over Japan, furnishes in its bulbs, called Udzu (Shurku by the Ainos), the familiar poison with which the Ainos arm their hunting-arrows. It is the same Coniin $C_8 H_{17} N$, which is found in the bulbs of other aconites also, and has lately been artificially reproduced.[1] It produces convulsive movements and paralysis in animal organisms.

The fruits of the Skimi, which is consecrated to Buddha and therefore much grown about Buddhist temples and cloisters, made a great stir some time ago. They came to market as a spice, instead of the Staranis, which they closely resemble, and turned out to be poisonous. Quite a different *rôle* is played by its bark, which is pulverized and then, with the help of a little resin, formed into small brown sticks, of the thickness of quills. In this shape they are the "smoke-candles" with which incense is made before the idols. These glimmering candles are also used with the Mogusa (pronounced Moxa). This is a peculiar sort of plaster, used to avert diseases. The Moxa or pieces of blossom of the *Artemisia vulgaris* are dried with the felt that surrounds them. A piece of this is laid on the naked body and then burnt by contact with the glimmering candle. This gives rise to wounds and later to scars as big as a shilling, such as one can frequently see, especially on the backs and posteriors of labourers.

The above-mentioned plants hold no position whatever in the commerce of Japan. They supply a home demand only, and have no place at all, in comparison with ginseng and camphor, two oriental drugs which deserve a more thorough consideration, not merely because of the strange mode of their acquisition and use, but also as being noteworthy articles of export from Japan.

(15) *Panax ginseng*, C. A. Meyer (*Aralia ginseng*, Jap. Nin-jin, Chinese Jin-san). Kaempfer says of ginseng, that next to tea it is the most celebrated plant in the whole Orient, on account of its root. It is closely related to the umbelliferous plants, and is a perennial growth, of the family of the *Araliaceæ*. Its cylindrical, carrot-like root yields the medicine so highly prized by the Chinese, Japanese, and Coreans. In fact this ginseng-root, or all-heal, as it is also called with us, the cinchona and the musk of these races, is a cure for fevers and weaknesses of all sorts—the chief and most costly medicine. Recourse is still had to it in cases of deadly illness, when nothing else will work. As characterizing both its costliness and the belief in its power to cure, we may repeat the Japanese proverb: "Ninjin kûte kubi kukuru," *i.e.*, literally, "After ginseng death by hanging," meaning "You will probably get well if you eat ginseng, but will die of hunger afterward, for it will make you poor."

From what has been said it is plain enough that Linnæus could

[1] See the recent experiments of A. W. Hofmann in the "Berichten der d. chem. Gesellschaft," 17. Jahrg., pp. 825–833.

hardly have found a more fitting name for the panacea of the eastern monsoon-region than the word Panax,[1] with which the ancients probably designated certain species of Ferula in Asia Minor and Pontus. He had heard of it through Kaempfer and others.

The ginseng-plant grows wild in the mountain forests of Eastern Asia, from Nepal to Manchooria. But in Japan it has only been found as yet in cultivation. In the deep woods of Chinese Manchooria, between 39° and 47° N. Lat., it was first observed by Pater Jartoux. But the roots gathered here with so much care, a prerogative of the Chinese imperial household, do not suffice for the large demand in that country. The supply has to be made up in part by a considerable cultivation of the plant in Northern China, in Corea, and Japan, and by a rather large importation from Philadelphia and Baltimore. These cities furnish China the roots of the less valuable *Panax quinquefolius* which grows in the Alleghany Mountains.

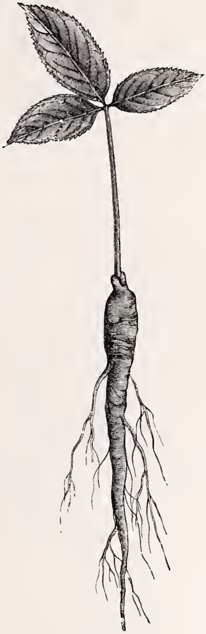


Fig. 2.

In Japan, black, loamy soil, in dry situations, is chosen for raising ginseng. Only in such earth does its tap-root grow sturdy enough, and of a white colour. In ferruginous soil it takes a reddish tinge, which lessens its value. The field is well manured, thoroughly dug up and prepared. Then it is divided into beds, which are, as a rule, 27 Japanese feet (8·13 meters) long, 2½ feet broad, and 2 feet apart. They always lie from east to west. To shield the plants from direct sunshine and heavy rains, each bed is covered with a thatched roof, running lengthwise ⅔ to 1 meter above the ground and supported on posts and poles. These roofs incline slightly to the south. Ginseng plantations are thus easily recognisable at a distance by an observant traveller, *e.g.* in the province of Shinano, by the side of the Nakasendo, in Aidzu, and elsewhere. While it is growing, it is only necessary to keep the ground clear and loosen the soil occasionally, besides manuring it several times with straw ashes.

[1] From πανακής, all-healing.

In Southern Japan (*e.g.* in the provinces of Idzumi and Hoki), sowing takes place in November; further north, however, not till

Fig. 3.

April. The seeds lose their germinating power easily, so they have to be kept mixed with earth for the spring planting. They are set in deeply-delved, thoroughly-pulverized soil, at intervals of 6 to 9 cm. and at that same depth. Each bed holds two rows about 30 cm. apart. Ginseng grows slowly, requiring $3\frac{1}{2}$ years to develop. There are therefore to be seen fields with plants of the first year

Fig. 4.

(ichi nen shô), of two years (ni nen shô), of three years (san nen shô), and of the fourth year (yo nen shô). Plants of the Ichinenshô (see fig. 2, page 137) have, up to autumn, put forth only one or two leaves and no stalk. A leaf of this sort, exclusive of its long stem, is 8–10 cm. high, and triple, like clover. The oval, pointed leaves have sharply dentated edges. The cylindrical, sturdy root appears more strongly developed. In the second summer it puts forth a simple, smooth stalk, which forks above into two or three petioles (see fig. 3, page 138). The individual leaves are now developed symmetrically into five leaflets, finger-shape, the middle one of these latter being strongest. In form and in character of their edges they are the same as in the first year. The root is about 12 cm. long, just about equalling the length of the part above ground. In the third summer (fig. 4, page 139) the upper part becomes 30–40 cm. high, sending out, half-way up, a crown of 3–4 leaves, in each of which the five leaflets are formed the same, but larger than in the second year. The smooth petioles have, like the round under-stalk, a red-brown colour. From the base of the leaves the plant's axis continues 10–20 cm. more, as a bare, greenish stalk, ending in a simple umbel, beneath and somewhat to one side of which there is sometimes a second, smaller umbel.

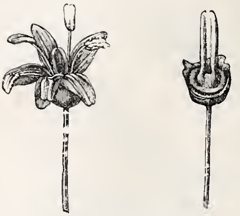


Fig. 5.

It is only when seed is wanted that the plant is allowed to blossom in the third or fourth summer. Otherwise the blossoms are cut off. Above a crown of 5–7 lanceolate sheath-leaflets is arched the small umbel, radiating in 10–20 directions, and reminding one of the Allium species. The umbel has light-green, polygamous blossoms, which are composed of unassuming, superior, five-toothed calyx, five petals, five stamens, and two or three styles. The inferior fruit-capsule develops into a bright scarlet berry as big as a pea, and flattened, which encloses two grey, furrowed grains the size of hemp-seeds (fig. 6, page 141). After these have been gathered they are buried 30–50 cm. deep in the ground till November or the next spring, so as to retain their germinating power until planting time. Ginseng roots are harvested in the Doyô (July and August) of the fourth summer. They are cylindrical, never thicker than a man's finger, and often divided towards the bottom like a fork (fig. 7, page 142). They are white, and smell and taste something like carrots (*Daucus carota*). The ordinary weight of a fresh ginseng-root is 20 to 25 grammes. They seldom weigh twice that much, and the product of a sq. meter of land amounts to 1 to 1½ kg. of fresh roots. After being dug up they are freed from fibres and other attached substances, and carefully washed. Then they are scalded with boiling water or steam, until, on being cut across, they have a brownish yellow and jelly-like appearance. Then they are set out in kilns, each containing about twelve drawers, one above another, their bottoms being made of stout paper. Here they stay for two or three days, according to their size, enduring a temperature of 100° to 120° C., which renders them perfectly dry and ready for market. But sometimes this drying is done in the sun, in which case it lasts correspondingly longer.

These prepared and dried ginseng roots have only about one-fourth of their original weight; 160–200 of them go to one kilogramme. In colour they range from yellowish to brown. They

Fig. 6.

are semi-diaphanous, somewhat brittle, and have a bitter-sweet taste, which excites mucus. They have to be carefully protected from dampness and small beetles (*Rhynchophorus*), and are used in the form of decoctions and extracts. The stalks and leaves of the plant are utilized also, being boiled to a black, sticky paste, which, in consequence of its sugar having gone over into caramel, looks and tastes like liquorice, though with a bitter twang. This preparation is not exported.

There are many buyers of the prepared ginseng-root, who pay

5–7 yen for a kin (600 grammes). In China it is worth 10 yen, or 40 shillings. The ginseng of Manchooria fetches a much higher price, especially the sort most in demand, which looks like amber, and which is often paid for in five to eight times its weight of silver. Equally esteemed is the ginseng of Corea, which is still an important item in exportations. In the Tokugawa period the Daimiô of Tsushima was exempt from taxation, but had to furnish instead a certain quantity of ginseng yearly to the court of the Shôgun, from the neighbouring Corea.

Fig. 7.

Now that the younger Japanese physicians have begun to get more and more acquainted with the European methods and means of treating diseases, the ginseng-root has fallen very much in public esteem in Japan; although its cultivation is about as great as ever, and in some places greater, since it is shipped more and more every year to China, where it always finds ready purchasers. Its exportation used to be in the hands of the Dutch, at Nagasáki; now it takes place directly, mostly via Ôsaka, through Japanese and Chinese. In 1879 it reached the high figure of 507,494 yen; since then, however, it has fallen off a little.

Ginseng is cultivated in several hilly districts, at a height of 300–800 meters, principally in Hondo. The chief of these are:

1. In the province of Idzumo, south of the capital Matsuye, on the mountain slopes of I-wu (I-wu-gori), and on the little Radish-island (Daikon-jima) in the Nakano-umi.

2. In the province of Hoki, on the northern side of the Daisen.

3. In Shinano along the Nakasendô, between the post-stations Iwamurata and Wada, and also near the city of Takeda, on the border of Hida.

4. In Aidzu, about 140 miles north of Tôkio, in several places, especially near Terayama and Matsukawa, and also near Kuradani and Uchi, on the road from Sannô-tôge to Wakamatsu.

Besides these parts of the country, where ginseng cultivation was observed by Kempermann or myself, it is also found, according to Maximowicz, near Hakodate, and in various other parts of the Japanese empire, as can be seen in the Catalogue of the Exhibition of Agricultural Products held in Tôkio in 1877.

For a number of years the immense demand for ginseng in China has been supplied in part, too, by the United States. The roots of a species (*Panax quinquefolius*, L.) indigenous in the Appalachian range, have been prepared and put upon the Chinese market. According to the reports of the commissioner of agriculture, nearly $700,000 worth were exported in 1877.

(16) *Cinnamomum camphora*, Nees and Eberm. (*Laurus camphora*, L.), the camphor-tree or camphor-laurel, Jap. Kusu-no-ki (pronounced Ksúnoki). This is the giant among foliaceous trees in Japan, exceeding all others, not only in girth, but in height also, not excepting *Planera acuminata*.[1] Its weak representatives in our green-houses, with their yellowish-green leaves and sickly look, give scarcely an idea of the grand form with its dark-green foliage which the producer of *camphor* (Jap. Shônô) attains in its home. But beyond the Alps, on the beautiful shores of the Northern Italian lakes, in the Riviera, and further south, where the tree flourishes and is distinguished for its rapid growth, we get a more adequate conception of it. One specimen, for instance, in the park of the well-known Villa Pallavicini near Pegli has grown a stem of one meter in circumference, in 25 years. Even more astounding is the growth of a camphor-tree in Cannes, which has been raised from seed sown in 1871, and had in the autumn of 1878 a girth of 98 cm. at the base, and a height of 30 meters. Much older and still more stately is the camphor-laurel in the botanical garden at Pisa, perhaps the largest specimen in Europe.

The quick growth of the tree in the Mediterranean region, however, is not the only remarkable thing about it. It accommodates itself easily to the hottest and driest climate in that region, notwithstanding the rainy character of its home in East Asia. It is one of the few Japanese plants which thrive in the Canary Islands, for example, and has even grown sturdily at Schubrah, near Cairo. The *Laurus Camphora* flourishes also in various other tropical and sub-tropical parts of the world, *e.g.*, at Buenos Ayres and in Mauritius. Under these circumstances it is surprising that plantations to obtain camphor have not been established anywhere.

The camphor-tree is the principal and most widespread Japanese

[1] Kaempfer compares it with a linden.

representative of the evergreen genus *Cinnamomum* of the laurel family. All species of *Cinnamomum* are marked by their odour of volatile oils, which are developed in various parts of the tree, and also by their leaves, which are long-stemmed, quickly warping, even-edged, leathery, and of a bright dark-green colour. In most cases they are placed alternately, and are further distinguished by a characteristic three-branched veining. The change of leaf takes place, as with most evergreens, in April, when the young, delicate, yellowish-green foliage displaces the dark-green leaves after the latter have lost their brightness. The young branches of the Kusunoki break off easily, and after every heavy wind a large number of them are found on the ground. Hence the camphor-tree rarely develops a symmetrically full crown. But what it thus loses in beauty is made up by its mighty form. Apart from the difference of foliage, and in the production of blossom and fruit, an old camphor-tree resembles nothing so much as a stately oak, in its thickness of trunk, the want of symmetry in its crown, its mighty gnarled and twisted boughs, and its rough, torn bark. This is especially true of the specimens, sometimes very old, found near the temples and in the old parks of the southern castle-cities. Fortune says that he never saw such large old camphor-trees in China as at the old temples in Nagasáki.[1] But surprisingly large specimens occur also in other and more northerly parts of Japan. Thus in the spring of 1875, in the province of Kii, on the road from Wakayama to the celebrated cloister-town Kôyasan (about $34\frac{1}{2}^\circ$ N. lat. and $135^\circ\ 20'$ E. long. Gr.), I saw such a tree at Kaseda-mura, with a trunk circumference of 11·5 m. At a height of $1\frac{1}{2}$ m. the giant divided into a number of mighty, wide-branching boughs. In the northern part of Tôkio, in the park of Uyeno, there is a tree near the temple of Gongen-sama, the lofty trunk of which at breast high had in 1874 a circumference of 5·88 m., and at a height of 40 to 50 m. still partially overshadowed with its thick boughs the slender coniferous trees around it (Cryptomeria and firs). Another large specimen is to be seen in Hon-jô, on the left side of the Sumida-gawa. Here, in the capital, these trees have to endure a winter of seventy to eighty nights of frost, in which the temperature sometimes sinks to -7° C., and in exceptional cases even to -9° C.

In Northern Italy, too, *e.g.*, on Lake Maggiore, the camphor-laurel endured, in December, 1879, a cold of -9° C. But it seems to have reached at this point the lower temperature-limit within which it occurs in the open air, for I did not find it north of the thirty-sixth parallel, even on the flat, mild coast of the Pacific. In the rough highlands of the interior it nowhere occurs, even more to the southward.

[1] Kaempfer saw in Kiushiu, in 1691, a camphor-tree which was noted for its size. In 1826 von Siebold found it still growing and thickly leaved. Its hollow trunk was then 16·884 m. in girth.

From those occurring near temples and human habitations, we must, however, distinguish well others in a wild condition. In this state it nowhere crosses the thirty-fourth parallel, confining itself to the mild hill-country near the sea, in Southern Japan. These are parts of Ôsumi and Satsuma on the Bay of Kagoshima, of Hiuga on the island of Kiushiu, and above all the province of Tosa on the island of Shikoku. Kaempfer and Thunberg say that the tree is frequently to be found, too, on the Gotô (*Gothô ôar*, Thunb.). In the regions named it forms a constituent of the evergreen forests, mixed with several other species of the genus Cinnamomum, with laurel-leaved oaks (*Quercus cuspidata*, *Qu. acuta*, *Qu. glauca*), *Camellia japonica*, and other more shrub-like growths. But such stout, old, thick-barked specimens as those in the temple-courts, do not occur anywhere here.

As to the general geographical distribution of *Cinnamomum Camphora*, it only extends over parts of the eastern monsoon region, embracing the coast-countries of East Asia, with many interruptions, from Cochin-China to about the mouth of the Yang-tse-kiang, including the islands of Heinan and Chusan, the island of Formosa, the Riukiu Islands, and the parts of Kiushiu and Shikoku already mentioned; thus comprising a region between 10° and 34° N. Lat., which belongs, therefore, partly to the tropics, partly to the sub-tropical zone. This region is marked by plentiful rainfalls, especially in summer. Hence its climate is especially favourable to a luxuriant development of vegetation. According to all reports, the camphor-tree is found most frequently on the island of Formosa, and most chiefly in the hilly and mountainous districts in its north-western portion. Formosa has for a long time furnished the largest amount of camphor, its only other important articles of export being rice and sugar. It used to be brought in junks to Hong-kong, Amoy, or Futschau first, and from there to Europe; but now it is sent directly from Tamsui.

In China Proper, Fukien is the province that is richest in camphor-trees. It is to this province and its product that Marco Polo refers (Yule: "Marco Polo," ii. 217), as well as many another later traveller in its forests. These latter still yield annually about 2,500 piculs (150,000 kg.); and the production has been known to reach 4,000 piculs (240,000 kg.) in one year.

Adjoining the area of the Laurinean camphor is that of borneol—Baros or Sumatra camphor.[1] This species of camphor is found stored in hollows and fissures in the wood of *Dryobalanops Camphora*, Colebr., a tree of the Dipterocarp family, but seldom in quantities of more than a quarter to one pound to a tree. This camphor-tree grows in Sumatra and West Borneo. Junghuhn speaks of it thus: "Among the forest-trees of Tapanuli (on the west coast

[1] Flückiger, in his very readable article "Camphora" (Pharmakognosie des Pflanzenreichs, 2. Aufl, p. 148), makes mention also of the Blumea-camphor, which, however, has no connection with Japan.

of Sumatra, north-east of Nias, and south-east of the city of Baros) the traveller's attention is attracted above all by the camphor-tree (*Dryobalanops Camphora*), distinguished for its colossal, straight, columnar trunk and its crown of leaves, which rises high above the forest carpet. It exceeds in dimensions the Rasamala (*Liquidamber Altingiana*), the highest tree of Java." [1]

Both kinds of camphor were undoubtedly known and valued throughout South and East Asia as early as the beginning of the Christian era, as shown by the fact that it was brought into Europe by Arabs in the first century. All through the Middle Ages, and down to quite recent times, Borneo camphor especially was held to be a medicine of the utmost importance, even by the Chinese and Japanese, who greatly preferred it to their native sort. Its proper Malay name is Kápúr Báròs or Barús, *i.e.*, camphor from Baros, the chief place of export on the north-west coast of the island of Sumatra, in distinction from Kapur China or Kapur Japún, Laurel camphor. Sumatra camphor came from Baros, but also from the other parts of the north-west coast between 1° and 2½° N. lat., viz., Tapanuli, Natal, and Ajer Bangngies, viâ Padang to Batavia, and viâ Atschin to Penang and Singapore. The Arabs, among others, adopted the name Kápúr, applying it also to the camphor-tree, as may still be observed in Egypt. Marco Polo was the first European to mention Sumatra camphor. He calls it Camfora Fansuri, and says it is so fine that it is bought in China for its weight in gold.[2]

Kaempfer states[3] that a Catti (605 grammes) of imported Borneo camphor is exchanged for 80–100 Catti of Japanese camphor, and de Vriese writes as follows, in his previously mentioned article on Sumatra camphor: "Une caisse de camphre, qui contenait en tout 125 livres de camphre en trois difféntes qualités rendait au Japon un prix de 2,500–3,000 rijksdaalders, c'est-à-dire d'environ 12,500–15,000 francs." He further remarks: "Pendant les années de 1750–1760, le commerce de cet article avec la Chine a rendu à la Compagnie le provenu considérable de 153,490 florins." This high estimation of the Ping-pien (ice-flakes) or Lung-nan (dragon's-brains), as the Chinese call Sumatra camphor, appears still to exist, for, according to the same authority, the total amount of this article exported from Baros (less than 400 kg. annually) goes to China, where its price exceeds that of the native product a hundredfold. In the year 1760 it cost 44 Dutch florins per picul in Padang, and about 60 florins in 1860, against 114 florins in Canton and Shanghai. It has been valued not only as an internal medicine and a cure for eye-diseases; it used to be employed for another quite

[1] W. H. de Vriese, in 1856, gave a detailed description of the tree, with an illustration, under the title: "Mémoire sur le Camphrier de Sumatra et de Bornéo."

[2] Yule: "Marco Polo," ii. 282.

[3] E. Kaempfer: "Geschichte und Beschreibung von Japan," 1777, p. 131.

different purpose in Sumatra. When a rajah of the Battas died, his corpse was laid in a coffin made from the wood of the *Durio zibethinus*, and there embalmed in camphor and kept enclosed till the rice sown on the day of his death could be harvested—five or six months later. By this time the body had become a mummy. It was then buried, together with this new rice. It has been calculated that this custom, every time it was honoured, cost 50–100 pounds of camphor, worth 2,000–5,000 florins.

In the early half of the eighteenth century there was a lively trade with Japan in this Sumatra camphor. But, according to de Vriese, the books of the Dutch Company make no further mention of it after 1768, so that it probably ceased then.

When the Portuguese first went to India, both kinds of camphor were known there and used in medicine. A picul (60 kg.) of first-class Sumatra camphor brought 1,360 dollars. The same weight of Chinese camphor cost 42–45 dollars, the relative values being, therefore, from 1 : 34 up to 1 : 30. The fame of the Borneo camphor was known to Camôens, who dedicated a verse to it in his "Lusiad," canto 10, line 133.

Laurel camphor (Japanese Shônô) is obtained from the chips of the freshly felled timber, by distillation with water, at all seasons, but usually in summer. A very sharp, concave adze, with a short handle, is used, with which trunks, branches, and the thicker roots are laboriously hewn into chips, such as fly off in felling a tree. The apparatus used in obtaining camphor, and especially the arrangement for receiving and condensing the fumes, are not everywhere the same. The one which I saw in operation in the woods not far from Kôchi, the capital of Tosa, was constructed as follows: On a crown-shaped foundation of primitive masonry (see fig. 8) $\frac{2}{3}$ m. high, which encircled the fire-place (F), there rested an iron pan (P), and on this a wooden tub (K) 1 m. in height. The bottom of this, which was perforated, measured 50 cm. in diameter, while its upper opening was 37 cm. wide. This vat was surrounded by a layer of mud (W) from 12 to 15 cm. thick, which also rested on the wall below. Before putting this apparatus in operation, the iron pan was filled with water from above, and the vat almost up to its brim with fresh chips. Then a cover (D) was set on top, and plastered steam-tight to the edge of the vat with mud. Then the fuel in the fire-place (F) was kindled. Steam is soon generated. It rises from the pan through the perforated bottom into the vat, where it settles on the chips of camphor-wood, and heats them through. Then, carrying with it the camphor-fumes, it passes off into the cooling apparatus (C) through a piece of bamboo cane (B) which fits in tightly near the upper edge of the vat. This cooling-apparatus lies on a contiguous hill-side, and consists of two water-tight troughs or boxes, of different sizes. The larger of them stands on the ground, open side up, and is divided by parallel boards into several communicating compartments, like a pneumatic separator. The smaller lies in the other, bottom-side up, being the receptacle for the steam. A piece of bamboo cane (B^1) pours a steady stream of water over its bottom and down over its walls to the separator below. Through a hole half-way up the side of this the overflow runs off. In about twelve hours the chips are exhausted. A valve (V) near the bottom of the vat (the joint having been hitherto closely sealed), is now opened, and the wood withdrawn. It is dried before the fire, so as to serve for fuel in the next filling.

Camphor and camphor-oil are now found collected on the water in the cooling-apparatus. They are skimmed off and separated from each other by filtration through straw or by pressure.

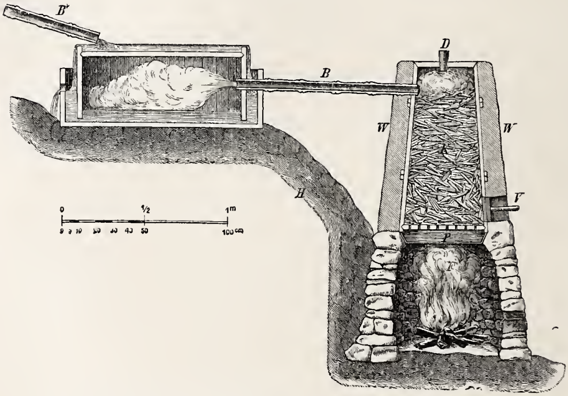


Fig. 8. APPARATUS FOR PRODUCING CAMPHOR IN TOSA, JAPAN.

The description of camphor manufacture given by Thunberg differs from this. He says that on an iron kettle there rests a wooden cover, terminating in a long point, in which straw was fastened; that the camphor-chips are boiled with water in the kettle; that the steam, rising, collected and condensed in the straw of the point of the cover, from which it was then separated as a granular, greyish white mass, to be packed in wooden tubs, and sold by weight to the Dutch Company in De-shima.

There can be no doubt that the process I witnessed marks a notable advance over that just described. In Japan it is not customary to soak the chips several days in water before beginning distillation, as is said to be the method in China. Scherzer describes the manufacture of camphor in Formosa. It agrees in its main features with that given for Tosa, but the contrivance is decidedly more primitive than here.

As might be expected from the more careful manner of its manufacture, Japanese camphor is much purer and more valuable, and therefore commands a higher price than Chinese. It is a granular, greyish white substance, not unlike the lumpy *Firn* (coarse glacial snow) of our high mountains, or white, unrefined sugar. It is obtained chiefly in Tosa. Since Kôchi, the capital of this province of the island of Shikoku, is in direct steamship connection with Ôsaka, it reaches European hands mostly viâ this city, and is shipped from the neighbouring town of Kobe (Hiogo). The exportation of camphor from Nagasáki is scarcely one-third as large as that from Hiogo. Still less is that from Yokohama. Tamsui in the northern part of Formosa and Hiogo, are at present the chief places for obtaining this drug, though the annual exportation from them and other places varies exceedingly, having in recent years ranged between 18,000 and 24,000 piculs—1,080,000 kg. and 1,440,000 kg.—at an average price of £12 per picul, or 4*s.* per kg. Before Formosa appeared in the market as the principal producer of this article, a picul of Japanese camphor was worth from £20 to £24, while the present price is £14 to £17. In the year 1876, Ôsaka-Hiogo exported 8,393 piculs of camphor, at a value of £121,846; in the previous year, however, only half as much. The total value of the Japanese shipments of this drug amounted, in 1872, to £152,879; in the following year to only £71,026. Since then the exportation of camphor from Japan has increased considerably, amounting in 1882 to more than 5,000,000 yen.

The properties and uses of camphor can be found in any textbook of chemistry and pharmacy, and are so well known that it would be superfluous to enumerate them here. But an application peculiar to Japan and China seems to me worth mentioning, namely, its general use for thinning lacquer. It is thoroughly mixed with lacquer, while itself hard, by means of a spatula, until it becomes fluid, and thins the lacquer also. And there can be no doubt, either, that the brownish camphor-oil (*Ol. camphoræ japonicum*), which appears as a subsidiary product of camphor manufacture, is the primary product, from which camphor ($C_{10} H_{16} O$) is formed by oxidation. It is a substance that bleaches gradually in the light, and resembles turpentine-oil, not only in odour, but also in chemical composition ($C_{10} H_{16}$). Borneïn, or Borneo camphor-oil, agrees with it in this. The close relationship of borneol ($C_{10} H_{18} O$) with Japanese camphor, and the easy convertibility of the one into the other, have been shown long ago.[1] Camphor-oil is an excellent solvent for the solid camphor, but is not used for this purpose in any other technical or pharmaceutical way, but

[1] Of recent treatises on this subject, see Kachler and Spitzer in the "Sitzberichte der Wiener Akademie," Band 80, pp. 197–216.

only burnt in lamps, an application for which it is very poorly fitted, on account of its sooty flame.

The wood of the camphor-tree is much employed in Eastern Asia for the manufacture of cabinets, chests of drawers, small chests, etc. This is especially the case at Otami, and in the Hakone Mountains, a day's journey to the west of Yokohama. It has a fine grain, a clear, yellow-brown colour, a silky sheen, and a beautiful appearance, so that it is well adapted to veneering. Not being subject to the attacks of insects, it might be recommended on this account as a material for cupboards and chests of drawers, especially in countries where termites and small red ants are a real plague, as in the West Indies and West Africa.

(*c*) *Oil-plants and their products.*

Japan possesses a considerable number of plants, some wild, others cultivated, from the seeds of which fatty oils (Abura) or tallowy and waxy fats (Rô) are manufactured. Only a few of them are of much industrial importance—particularly the oils of rape, sesame, the Perille, the Camellia, and the vegetable tallow or Japanese wax of several kinds of sumach. This last is also an export of consequence, holding sixth place in the lists given in the English consular reports.

The following serve as food-oils: Goma-no-abura, sesame-oil (from *Sesamum orientale*), Kaya-no-abura, Kaya-oil (from *Torreya nucifera*), Buna-no-abura, beech-oil (from *Fagus Sieboldi*), Rakkashô-no-abura, groundnut-oil (from *Arachis hypogæa*), Karashi-abura, mustard-oil (from *Sinapis cernua* and *S. integrifolia*), Tane-abura, rape-oil (from *Brassica chinensis*), and some others. For burning in lamps (Andon) Tane-abura, rape-oil, Dokuye-no-abura (from *Elæococca cordata*), Hyobu-no-abura (from *Cephalotaxus drupeacea*), sometimes also Giôto, or fish-oil (from different members of the herring family) are chiefly used. Gas and especially petroleum, have, however, considerably diminished the use of the fats as agents for lighting in Japan. The principal articles used for hair-oil are Tsubaki-no-abura, camellia-oil (from *Camellia japonica*, *C. Sasanqua*, and *C. theïfera*, the last called also Cha-no-abura, tea-oil). And finally, for technical purposes, the kinds most used are Ye- (pronounced Ā) no-abura, the oil of *Perilla ocymoides*, Tô-goma, hempseed-oil (from *Cannabis sativa*), Zokudzui-shi, spurgeworts-oil (from *Euphorbia Lathyris*), and Shira-shibori, cold-pressed rape-oil, as well as the Rô from the sumachs.

In manufacturing these various vegetable-fats, the Japanese, as well as the Chinese, employ wooden wedge-presses of various constructions. A reproduction of one of these is given by Stanislas Julien, in his well-known book, "Industrie de l'Empire Chinois," p. 119. Another kind is that which I frequently saw used in

Japan, not only for oils, but also for vegetable tallow, and of which a sketch is given here. Its arrangement and mode of operation need no further explanation. Of course the fatty substance, after being chopped up in a simple stock, is generally heated before it is put under pressure in the hollowed stone, or block, or box, as the case may be. As with us, the seed-meal is wrapped in bags or cloths. It often happens that the arrangement for receiving the liquid oil does not simply stand on the ground, but is sunk into it.

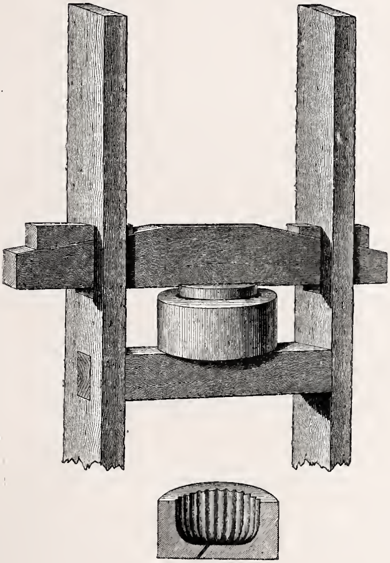


Fig. 9.

The extraction of oils by chemical process has never been in operation in East Asia, for almost all the solvents of oil in use among us are lacking.

As to the several fats mentioned above, and their products, the following statements may be here made :

1. Tane abura, the oil of rape-seed (Na-tane) is mostly burned in lamps. Because of the harsh taste it imparts to food, its use in the kitchen is confined to the place where it is produced. This

rape (*Brassica chinensis*, L.), called Na, Abura-na, or Tô-na, is more largely cultivated in Japan than all the other oil plants—so too in China, I suppose—and, to the best of my observation, always as a winter crop. Seed time is in September or October; flowering in April, and harvest in July. It is often planted side by side with rice. In this case it is frequently raised in seed-beds, and transplanted in rows beside the rice. When Tane-na is heated before pressing, you get the common Tane-abura; with cold pressing, however, the clearer and better Shira-shime or Shira-shibori, which is used principally for oiling tools and machines.

2. Karashi-no-abura, fat mustard-oil. This is manufactured from the seeds of *Sinapis cernua*, Thunb. (Karashi or Karashi-na), and also from *S. integrifolia*, Wild., the Ô-garashi (big mustard), and Taka-na (high rape) of the Japanese. It is clearer and softer than rape-oil, and is therefore preferred to this for food. I found both kinds very frequent in Kiushiu, *e.g.*, in the province of Higo, and was impressed by the appropriateness of the term Taka-na (high rape) for the one. Its stalks reach a height of about 2 m., and hence stand high above those of rape, which it resembles. They are raised at intervals of 15 to 20 cm. in rows that are about 85 cm. apart. By the middle of April the mustard fields around Kumamoto were in full bloom, but the rape beside it had already advanced beyond that stage. Mustard is used in Japan as with us, for a sort of condiment, and its volatile oil is developed in the same way; but for the most part it is grown for similar purposes as rape.

3. Tsubaki-no-abura, Sasank'wa-no-abura, Cha-no-abura. Under these names the thick oils from the nut-like seeds of the following plants are known in Japan, where they are used principally for the hair: *Camellia japonica*, L., Jap. Tsubaki, *C. Sasanqua*, Thunb., Jap. Sasank'wa, and *C. theïfera*, Griffith, Jap. Cha. These contain 30–35 per cent. of oil.[1]

Only those tea-nuts which are not needed for planting are used for making tea-seed-oil. But the two other kinds of camellia are grown specially for their oily seeds. Thus, for instance, in the coast-country of Sendai and Nambu on the Pacific Ocean, between latitude 38 and 40, camellias are planted either singly or in rows along the edge of many a field or roadside. They are regular trees, some of them having straight boles 4 to 6 m. high and 30 cm. in diameter. Their shapely dark green crowns stand out sharp against the fading foliage of most of the other growths, especially in autumn. The fruit, which is round and the size of a pigeon's egg, becomes red-brown under the sun's direct rays. When overripe it becomes dark and even black—inside as well as out—and then bursts out in three spots, letting fall three long, angular, dark grey nuts.

The Tsubaki-no-abura that is got from them is the highest-

[1] With regard to the first two, see the chapter on ornamental plants. Details as to *C. theïfera* (*Thea chinesis*, Sims.) are to be found under 3*a* Tea.

priced of all Japanese oils (75 sen per shô, or 3 shillings for 1·75 liter). Its colour ranges from amber to straw colour. Its specific gravity is 0·927 at 14° C. It congeals at between −4° and −6° C. Its weight consists of oleic-acid and stearic-acid glycerides, in proportion as $\frac{3}{4}$ to $\frac{1}{4}$. In China it is said to be utilized, like tea-oil, which resembles it closely, for food, light, and the manufacture of soap. The oil of the Sasanqua is clearer, though in other respects not differing greatly from the foregoing.

This plant is cultivated in Suruga, in Kiushiu, *e.g.* in Hizen, in Amakusa, and in several other districts, just like the tea plant. It grows in the shape of spreading bushes from 2 to 4 m. high, never as trees, and is in general more like the tea-shrub than the common camellia, in regard to its season of blossoming for example, this being in November and December.

4. Wata-no-abura, cottonseed-oil. Cotton seeds (Wata-no-mi) have only lately been utilized in Japan, as elsewhere, to produce a heavy (specific gravity 0·926), thick, brown oil. This is made *e.g.* in Awa, on the Island of Shikoku, from seeds of *Gossypium herbaceum*, and is used for lamps, though, like hempseed-oil, which it recalls in smell and taste, it creates a sooty flame. When refined, it is straw-coloured and has a nutty taste. In this state it is used in Europe as a food-oil—olive-oil, which is double the price, being frequently adulterated with it.

5. Rakkuwashô- (pronounced Rakkashô) no-abura, groundnut-oil. It is yielded by *Arachis hypogæa*, L., Jap. Rakkashô, or Tojin-mame, the ground-nut (pea-nut, pistache de terre, and arachide). It is used for food, and is produced only in small quantities, in Southern Japan. A very considerable botanico-geographical interest attaches to this remarkable leguminous herb. Numerous leaves appear on its low-lying, branching stalk. These are elliptical or oval, inverted, and at their axils grow short-stemmed, yellow blossoms. When these have disappeared their stems lengthen out, the joints sink into the loose sandy soil, where, at a depth of 5–8 cm. below the surface, they develop into little pods, 15–30 mm. long, and 10–15 mm. thick. As a rule they have a constriction in the middle, deep and gradual, reminding one in this respect of the male cocoons of many breeds of the common silk-worm, which they resemble also in their entire shape, and in size and their reticulate surface, though less in their grey-white earthy colour. These shells contain a seed on each side of the constriction. Shorter ones, without constriction, hold only one. These seeds may be compared to the kernels of long, medium-sized hazel nuts. Externally, they are a brownish red; inside, white. They yield 40–60 per cent. of a fatty oil, which serves almost all the purposes of olive-oil. The taste of the seeds when raw resembles that of all leguminous plants; when roasted, that of almonds, pistachios, and other nuts, as the various names indicate.

Brazil was formerly considered to be the original home of the ground-nut; but now that it has become known how widely distributed it is in Africa, this opinion has been relinquished, and it is held more probable that it was introduced into the New World, by Portuguese slave-ships, from Africa. In the Old World it is found cultivated in many tropical and sub-tropical countries, though never to the same extent as on the West Coast of Africa, from Senegambia and the regions adjacent down to the Gold Coast, where it is a prominent article of export. Marseilles is the chief market for ground-nuts and the oil they yield, as well as for oil-seeds in general. In Japan and China, as well as in North America, ground-nuts are usually eaten roasted, and their cultivation is very limited.

6. Goma-no-abura, sesame oil. *Sesamum indicum*, D. C., Jap. Goma, the plant that yields this food-oil, so highly prized by many peoples, has long been widely distributed over most of the warmer countries of the earth, from the East Coast of Asia to the shores of the Mediterranean, on the East and West Coasts of Africa, and also in the New World. It grows, too, in the interior of Africa, where, *e.g.*, E. Vogel found the islands of Lake Tchad planted with it. De Candolle, from good grounds, regarded India as its original home, and both forms—with black seeds (*Sesamum orientale*, L., Jap. Kuro-goma) and with white (*S. indicum*, L., Jap. Shiro-goma)—as mere varieties of the same thing.

In India, sesame goes by the names Til and Gingeli. In China it is called, according to Bretschneider, Chi-ma; and on the West Coast of Africa, Benni-seed. Marseilles is the great market for sesame, as for ground-nuts. Vast quantities of both the white and the black grain are imported thither from India, Siam, Formosa, the Levant, the East and West Coasts of Africa, and other sources. As a rule the white and black grain bear to each other, in price, the relation of 10 to 9; so in Japan, too, where the oil of the former, or Shiro-goma, sells at 30 sen per shô, when that of Kuro-goma stands at 27 sen per shô.

The sesame plant is a herb-like Bignoniaceæ. Its stiff stalk, furrowed on four sides, attains a height of 1 m., and bears, at its axils, the short-stemmed white blossoms, which have some resemblance in size and shape to those of our Digitalis species,—a fact that was hinted at in the names formerly in frequent use, "white or oriental fox-glove," The fruit is a four-chambered capsule about 3 cm. long, with four rounded edges. Its countless seeds are found in four rows about a central strip. In size and shape they remind one somewhat of linseed (being a flattened oval and pointed), but differ from them in colour, and in having no lustre. According to Flückiger's careful experiments,[1] their proportion of oil is 56·33 per cent., of which 48 to 50 per cent. can be obtained by pressure, and the whole amount by extraction. Sesame-oil, especially when cold-pressed, has a beautiful clear colour, and a specific

[1] "Schweizerische Wochenschrift für Pharmacie," 1868, p. 282 ff.

gravity of 0·9235, becoming congealed at $-5°$ C. Its flavour is agreeable, though not so mild as that of olive-oil, which is much dearer, so that it is often adulterated with it. Sesame-oil is readily recognised by the red colour which it assumes when equal quantities of sugar and hydrochloric acid, with a specific gravity of 1·18 are sprinkled into it. Groundnut-oil is third in the Marseilles oil-trade. It is recognisable and distinguishable from olive-oil by the Arachic acid, which proceeds with a mother-of-pearl appearance from the hot alcoholic solution of the precipated fatty acids in cooling.[1]

The sesame-plant is, however, not extensively cultivated in Japan. One often sees a bed of it here and there, or more frequently a border of it encircling beds of other herbs or whole fields. Hence the demand for food-oil is only partly met by this article, and recourse must be had to various others as substitutes.

7. Ye- (pronounced A) no-abura, more properly Yegoma-no-abura, oil from seeds of the Yegoma-plant (*Perilla ocymoides*, L.). It has served from time immemorial in Japan and China as a drying-oil, instead of linseed-oil. Like flax-growing in general, this oil was unknown to the East Asiatics until recent times. *Perilla ocymoides*, L., a Labiate characterized in all its parts by a strong, peculiar odour, is of slow growth. Its seed-time is in April, but the plants do not attain their full size till about the end of September or the beginning of October. Their many-branched stalks have by that time reached a height of 1–1·50 m. Then little white blossoms begin to appear in axillary ears, but soon drop off and cover the ground in the early half of October. Only a fortnight later the seeds are ripe—a quick development characteristic of most labiate plants. These seeds are of a greyish brown colour. They are much smaller than rape-seeds, and very friable. They fall readily out of their capsules, so that harvest must take place before they are fully ripe, otherwise there is danger that a stronger wind than usual may shake a large part of the crop to the ground.

According to the experiments of the chemist Cloëz, in Paris, Perilla seeds grown in the South of France yielded, by pressure, 30 per cent. of thin, colourless drying-oil ; 34·5 per cent. by extraction with bisulphide of carbon ; while Japanese seeds gave 39·2 per cent. This, like linseed-oil, is useful in painting, and in Japan possesses great importance for several technical purposes. It is used especially :—

(1) In the manufacture of oiled papers (Abura-kami) for lanterns, umbrellas, and waterproof cloaks.

(2) In the manufacture of the so-called leather-paper (Kami-kawa).

(3) As an ingredient of several kinds of lacquer.

(4) As an addition to the fruit-meal of the lacquer and tallow-tree, to obtain Japanese plant-wax more easily and perfectly.[2]

[1] Dingler's *Polyt. Journ.*, 1882, p. 324.

[2] For details in regard to the uses of Perilla-oil here mentioned, see the corresponding sections.

Oil-cakes, rich in nitrogen and phosphorus, are used to fertilize the soil. They would make just as good fodder as linseed-cakes.

To meet the above-mentioned uses, and others besides, we find that, next to rape-seed, the yegoma is grown more extensively than all other oil-producing plants in Japan. In England it has been known, from its Indian home, since 1770. Attempts to cultivate it have in recent times been made in the South of France. Thus Léon de Lunaret, of Montpellier, in 1878, sowed a piece of land measuring 50 square m. with 500 grammes of seed, harvesting 7 kg. of seed in return.[1] One ha will accordingly yield at least 500 kg. A further result of these attempts has shown that *Perilla ocymoides*, L., only finds in the Mediterranean regions a sufficiently long summer heat for its development, and its cultivation is impossible in higher latitudes in Europe.

8. Dokuye-no-abura is the name for oil from the nuts of the *Elæococca cordata*, Bl. (*E. verrucosa*, S. and Z., *Aleurites cordata*, Müll.), a medium-sized tree with wide-spreading crown, of the Euphorbiacea family—a tree cultivated in many parts of Japan, and also in China.[2] Of its four Japanese names, Dokuye, Abura-no-ki, Abura-giri, and Yama-giri, the second means "oil-tree," the third "oil-kiri," the fourth "wild-kiri." Kiri (giri) is, however, the name for *Paulownia imperialis*, which *Elæococca cordata* resembles—chiefly in its large, heart-shaped leaves, and partly too in the appearance of its stem. Its large white bunches of blossoms appear late in May and early in June; the capsules (for three and four seeds) get ripe in autumn, and remind one, as do also their contents, of Ricinus. The oil obtained from these seeds has only recently been closely examined by Cloëz.[3] It is numbered among the drying-oils, and serves in Japan for illuminating purposes chiefly. In China, where it bears the name T'ung-tsze-yu, *i.e.*, wood-oil, it is used also as a medicine, for greasing wood on ships, and other purposes. This is referred to in the name *Elæococca vernicea*, Spreng.[4] The tree is known all over Japan. It is usually planted in soil that is unfitted for farming, as in Suruga, Echizen, and Kaga.

The seeds of three other Euphorbiaceæ and the oils obtained from them, because of their use in medicine, are better known in Europe than the species of which we have just spoken. These are *Croton Triglium*, L., *Ricinus communis*, L., and *Euphorbia Lathyris*, L.

9. Himashi-no-abura is the Japanese name for Ricinus-oil. Ricinus (Himashi or Tô-goma, *i.e.*, Chinese sesame) is raised here

[1] *Revue Horticole.*

[2] The tree described by Kaempfer in "Amœn. exot.," pp. 789 and 790, under the name of *Abrasin* (*Ricinus arboreus*, fol. Alceæ), and by Thunberg in "Flor. jap." as *Dryandra cordata*, is undoubtedly the same. Both authors mention, besides, the oil for illumination, made from its seeds.

[3] See also Flückiger: "Archiv d. Pharmacie," 1876, pp. 208 and 422.

[4] From a statement in the Augsburg *A. Zeitung*, of June 6th, 1876, I learn that termites are expelled by means of this oil in China, and that the French consul in Canton recommended it to his government for the phylloxera vastatrix.

and there in small patches beside other medicinal herbs, never losing its herb-like character. Its oil, apart from purposes already mentioned, is used to produce red or black colour for seals.

10. Zokudzu-shi is the oil of the Zokudzui or Horutoso (*Euphorbia Lathyris*, L.). Only a small quantity of this is made, and it is used to protect iron weapons against rust. The swords of the Samurai especially, their favourite weapons, were kept bright by this means.

11. Asa-no-abura, hemp-seed oil, made from Asa-mi, hemp-seed (*Cannabis sativa*, L.), whose properties are sufficiently well-known, is also used for obtaining the red and black colours for seals and stamps.

12. Kaya-no-abura, Kaya-oil, is manufactured by the Japanese from the seeds of *Torreya nucifera*, S. and Z., the Kaya, which are like hazel-nuts or acorns. It is used mostly in the kitchen. The Kaya resembles our yew. It is found in most cases as of underwood, scattered like brush in mountain forests; seldom as a tree. In autumn the plant is laden with nuts, which are good to eat, although having a resinous after-taste.

13. Inu-gaya-no-abura is obtained from the nuts of the Inu-kaya, *i.e.*, Dog-Kaya or bad Kaya (*Cephalotaxus drupeacea*, S. and Z.). It is a resiny oil of small value, used only in lamps. The fruit hangs plentifully on its bushes, which are distributed through the upland woods. It is of the thickness of a small cherry, and rather long, and brown. The flesh surrounding its nuts has a sweetish, resinous flavour, and is not good eating.

14. Buna-no-abura, oil extracted from the beech-nut, beech being Buna (*Fagus Sieboldi*, Endl., and *F. sylvatica*, L.). It is used as with us, though not frequently.

Average Composition of various Japanese Oil-seeds, according to E. Wolff and others.

	Water per cent.	Ashes per cent.	Raw-proteine per cent.	Raw fibre per cent.	Non-nitrogenous extractive matter per cent.	Raw fat per cent.
Rape-seed	11·8	3·9	19·4	10·3	12·1	42·5
Ground-nut	6·3	3·2	28·2	13·9	7·2	41·2
Cotton-seed	7·7	7·8	22·8	16·0	15·4	30·3
Sesame (brown)	5·9	7·52	21.42	9·53		55·63
Sesame (white)	7·06	6·85	22·30	14·95		50·84
Hemp-seed	12·2	4·5	16·3	12·1	21·3	33·6
Shelled beech-nuts	10·5	4·12	24·0	40·00		21·26
Soy-beans	10·0	5·0	33·4	4·8	29·2	17·6

Taken from Ollich's "Die Rückstände der Oelfabrikation," Leipzig, 1884.

15. The solid Japanese plant-fats, especially the most important ones, which are obtained from the fruit of several sorts of sumach, bear the name Rô. In foreign trade it is called Japanese wax (*Cera Japonica*), vegetable wax, and Japanese plant-wax; but its resemblance to beeswax (Jap. Mitsu-rô) is merely external, and not of chemical foundation. It is similar to beeswax in appearance, consistency and the uses to which it is applied, but in its composition, like all other fats, it is a mixture of several fatty-acid glycerides.[1]

Among the six species of the genus sumach (fam. *Anacardiaceæ*) known in Japan, there are two of foreign importation, which are cultivated in different parts of the country and have acquired great importance, viz., *Rhus vernicifera*, D. C., and *Rh. succedanea*, L. The latter species probably originated in the Riu-kiu Islands, but it cannot be proved to a certainty that either is indigenous. The latter kind requires a milder climate than the former, and hence flourishes only in the warmer parts of the country, 35° N. lat., and 135° E. long. being, roughly, the northern and eastern limits of its cultivation. The object of cultivating it is to obtain plant-tallow from its fruit. Rhus vernicifera is grown for similar purposes in the colder parts of the island of Honshiu almost to the Tsugaru-strait, but more on account of the lacquer obtained from its sap.[2]

The fruits of the wild species of Japanese sumach, viz., Yama-urushi (*Rh. sylvestris*, S. and Z.), Nurude or Fushi-no-ki (*Rh. semialata*, Murr.), Tsuta-urushi (*Th. Toxicodendron*, L.), and *Rh. trichocarpa*, Miq., also contain solid fat, but in a less degree; but, with the exception of the first named, are never employed.

Rhus vernicifera, D. C. (*R. vernix*, Thunb.), the lacquer-tree, Jap. Urushi-no-ki, attains a height of 8–10 m., and with an age of forty and more years, frequently a girth of 1 m. During the first six years its growth is pretty quick, in favourable soil amounting to 50–80 cm. annually; then, however, it diminishes to an average of 25–50 cm. a year. The greenish yellow wood at its heart, which looks like Morus, Maclura, and other related genera, has therefore a relatively great weight. The younger, lighter wood is white, the bark is of a light grey, cracking with increasing age.

Lacquer-trees grow up straight and have fairly symmetrical crowns. But when old their branches are too few and their foliage too light and thin for beauty. On the other hand, young specimens, under fifteen years old, can be grown to advantage as foliage-trees

[1] An excellent treatise on this subject was published by A. Meyer of the Pharmaceutical Institute of the University of Strassburg, in Reichardt's "Archiv der Pharmacie," Bd. XII., Heft 2, 1879, under the title "Ueber den Japantalg." I made several contributions to this myself, *e.g.*, the drawing of the press, as the author conscientiously acknowledges. From the same institution, under the further encouragement of its deserving head, Prof. Flückiger, there has appeared a smaller essay by Dr. Buri, as more or less a supplement to that treatise, and with the same title, in the same journal, Band XII., Heft 5.

[2] Details as to the manufacture of this peculiar, costly material, will be found in the section devoted to the lacquer industry.

in landscape gardening, for the sake of their fine large pinnate leaves, which in good soil often grow to be more than a meter long, and far exceed all other species of Rhus in size and beauty. These leaves are unequally pinnate, and have long stems. Before falling off in October they become yellow or brownish red. Fresh leaves appear in May. There are from nine to fifteen leaflets, large, oval, pointed and unindented, and have fine short hairs on the under side.

In June appear loose, greenish yellow branches of blossoms, growing from numerous axils near the end of the thick twigs. The fruit is ripe in the second half of October—dry, yellowish green stone-fruit, which remain hanging all winter, though usually gathered in November.

In the case of the lacquer-tree, the two sexes are separate. Therefore when the chief object of its cultivation is the manufacture of fat from its seeds, male trees should be avoided, reproduction being obtained, not by seed, but by root-sprouts from female specimens. On the other hand, if the object is to get lacquer, propagation is brought about with seeds, because they furnish hardier, better-rooted trees.

Lacquer-trees bear fruit from the eighth year onwards. When eighteen or twenty years old, they are at their best for yielding lacquer, furnishing at that age the greatest quantity; and then they are sacrificed and replaced by others. On the other hand, lacquer-trees that are looked to only or chiefly for seeds and wax, as in Aidzu and South-eastern Echigo, reach a great age, increasing in productiveness up to their thirtieth, or even fortieth year.

The lacquer-tree flourishes, it is true, all over Japan, from the Riukiu Islands to Yezo. But in southern sections of the country it is only occasionally found cultivated, and nowhere extensively, despite the fact that its near relative, the tallow-tree, occurs there. The principal region of its cultivation is, however, Northern Hondo, between latitudes 37° and 39°. Large plantations are especially met with in the valley of the Tadami-gawa with the central Hibara in Western Aidzu, and also at Yonegawa and Mogami in Uzen, as well as in Northern Echigo. Many a village here lies, as it were, in a grove of lacquer-trees. Along the borders of valley-bottoms and in mountain-hollows, where rice and sometimes even other crops cannot be raised, lacquer-plantations are very often seen; less frequently, trees planted in rows and at regular intervals in cultivated fields, are found, like fruit-trees with us. But in no case are they manured like ordinary plants, for it is understood that their roots draw enough nourishment from the fields of themselves. As a rule, old and young trees grow promiscuously together—at least wherever reproduction is obtained through root-sprouts.

In South-western Aidzu the lacquer-tree is the chief of all the products of the field, shading the roads in some places, and is cultivated with great care. Under Daimio-rule there were exact regulations, even as to the minimum number of trees to be planted annually in each place. The punishment for injuring them was most severe. Female trees (me-gi) were allowed to be tapped only once in four years, in autumn, and at a few points only. It was believed that they were benefited by this, as by a sort of blood-letting, and accordingly it was called Yojo-gaki (Yojo = health-culture, gaki = kaki = scratching). By this means hardy fruit was obtained and a little lacquer, but that excellent. The production of wax was regarded as the principal thing. But with male trees (Ô-gi) every one could take what course he chose.

Aidzu-rô and Aidzu-rô-soku, *i.e.*, plant-tallow, and candles made therefrom, came from Aidzu, and had always a great reputation in Yedo. They are still much in use, notwithstanding the serious competition of petroleum. Their manufacture and peculiar properties are the same as those of the fruits of species next to be mentioned, and will be treated more particularly at the close. Yonezawa, north of Aidzu, yields in many years more than 30,000 kg. of Rô-soku from the Rô of the tallow-tree.

For many years an Indian shrub-like species of sumach has been cultivated in various botanical gardens under the wrong name of *Rhus vernicifera*. It, however, bears only a slight resemblance to our plant.[1] The real plant was actually unknown until I introduced it in 1875 and 1876. Lacquer-trees grown from seeds have developed especially well in the botanical gardens at Frankfort on the Main and Strasburg, so much so, indeed, that in one or two years it will be possible in the former to proceed to attempts at lacquer-making.

They stood splendidly the hard winter of 1879–80, when the thermometer stood at $-27°$C., thereby proving themselves quite proof against the winter climate of Germany. This fact is the more surprising when one considers that lacquer-trees in the snowy winters of Northern Honshiu are exposed to a temperature of $-12°$C. at the lowest. It proves that the possibility of acclimatizing a plant cannot be decided upon *à priori*, according to the actual conditions of its life as already known, but a certain capacity of accommodation must be taken into account, which varies greatly, and can be definitely determined only by experiments.

Rhus succedanea, L., Jap. Haze-no-ki or Rô-no-ki, *i.e.*, wax-tree or tallow-tree. The range of its cultivation, as has been said already, is in the south. The plantations of it I found farthest north in Kii, on the Linschoten Strait, where it develops more slowly and its fruit does not reach the normal size. The fruit falls still farther short of this in the botanical garden at Tôkio, so that there is no possibility of the plant succeeding in Germany.

[1] *Ailanthus glandulosa*, Desf., occurs frequently in France under the wrong name, "Vernis de Japon."

In Iyo and other parts of Shikoku, and also here and there in the district of San-yô-dô, on the Inland Sea, but above all in Kiushiu, the tallow-tree is largely cultivated. It often forms an important factor in the landscape here, covering the hillsides, the borders of fields and roads, and the dykes of rivers and canals. It has the habit of apple trees, though by no means reaching an equal strength. As it branches out earlier than the lacquer-tree, it spreads forth a wider crown and does not grow so high, being, as a rule, only 4 to 6m. high. Its primate-leaves are much smaller, but its fruit is larger, heavier, and richer in fat than that of the lacquer-tree. It bears a closer resemblance to the fruit of *Rhus sylvestris.*

Production of Sumach-tallow, and its Properties.

The dry stone-fruit of both the above-mentioned species of sumach is more or less kidney-shaped and, when ripe, of a bright yellowish green colour. In size they resemble small dwarf beans, as the Adzuki (*Phaseolus radiatus*). Its semi-transparent epidermis loosens and falls off easily, as is the case with all Japanese sumachs, especially *Rhus vernicifera* and *R. sylvestris*, so that in the case of the latter, for example, the greyish white fat of the mesocarp is visible soon after maturity all over the fruit-clusters. The fat belongs entirely to this middle layer, where it fills out the cells lying here loosely side by side. Between them are hard fibres (intercellular milk-juice passages), which intersect the mesocarp as in the nuts of oil and coco-palms.

In the case of *Rhus vernicifera* this middle layer lies loose above the stone or kernel, from which it is easy to separate it. But in the case of the real tallow-tree it adheres tight in spots. This may be the reason why these kernels are first separated in making Rô from the fruit of the lacquer-tree, while with the other sort they are left united with the crushed hull. In the former case separation is effected by stamping in round rice-troughs (Usu), after the stems have been removed. Then the mass is made to fall gradually on mats of rush, by means of a draught of air blown through an elevated sifter. The heavy kernels fall down first and are thrown aside as worthless. The meal from the epidermis and mesocarp is gathered up and heated with steam in hempen sacks, and then quickly subjected to pressure in the wedge-press. This process is repeated with the refuse.

This is substantially the method which I saw pursued at Murakami in Northern Echigo for obtaining tallow from the fruit of the lacquer-tree. I found it precisely analogous in Iyo, on Shikoku, where it was applied to the somewhat larger fruit of *Rhus succedanea.* The wedge-presses employed here were of the same construction, but more carefully worked. In driving in the wedge, the wooden rams were not swung free in men's hands, but were hung on ropes, and thus swung horizontally, a saving of the force which would have been otherwise expended in merely holding them. An iron kettle was employed here, as elsewhere, to warm the mass, which still included many kernel-stones. It was half-filled with boiling water; in its upper part rested a bamboo basket, lined with cloth, in which the fatty meal was steamed.

A wax-press shown me in Nagasaki had an entirely different shape and arrangement. It was the trunk of a tree, Keaki (*Planera Keaki*), hollowed out in the form of a flask, and bound with iron rings at both ends. The stuff was heated in hempen bags, then packed between stout round wicker mats, and pushed into the neck of the flask, which was turned upside down. To fill the remaining hollow space, thick, circular pieces of board were driven in from above by means of wedges. The vessel for receiving the fat, which flowed down through a tube, stood on a chafing-dish.

However the process of obtaining vegetable tallow may differ as to particulars in various parts of the country, it is in general still the same, and is insufficient to extract all the fat from the vegetable mass. This might be better done by adding some Perilla-oil, as has been mentioned by some, though I never observed it myself.

I made a comparative estimate of the weight of the several parts of the sumach fruits used for making tallow in Japan, and of the amount of fat extracted by means of ether. The results given by A. Meyer do not agree with mine, so I give them both. Meyer took, as he says, ten pieces of the fruit of *Rhus succedanea*, (from whence is not stated), and found that they weighed 1·51 gr. and consisted of 46·45 per cent. mesocarp. 42·36 per cent. epidermis and putamen (shell of the kernel), and 8·85 per cent. embryo, with a loss of 2·35 per cent., accounted for by dust. Grating the mesocarp, he extracted from it with ether 20·9 per cent. of the entire fruit, in tallow. The cotyledons yielded him in oil 2·65 per cent. of the entire weight, and 36 per cent. of their own weight. In my experiments I took considerable quantities of fresh, air-dried fruit of the lacquer-tree, from Murakami; of the tallow-tree, from Nagasáki, with a result as shown in the following table:

	R. vernicifera.	R. succedanea.
100 pieces of normally formed fruit weighed .	8·75 grm.	12·80 grm.
Of which the epidermis gave	5·7 per cent.	4·7 per cent.
" the mesocarp	39·3 "	42·4 "
" epidermis and mesocarp.	45·0 "	74·1 "
" endocarp (putamen and embryo). .	55·0 "	52·9 "
The fat extracted with ether weighed. . . .	24·2 "	27·0 "
Leaving for the stone-shells (putamen) . . .	20·8 "	20·1 "

The vegetable tallow that flows from the press into the receptacle soon congeals there into a solid mass. To rid this of impurities it is melted in iron kettles, and the clear wax skimmed off into small earthen saucers, from which it can easily be lifted out when cool.[1] It is always in this shape that it appears in commerce. It is used in many ways, but especially and extensively for making candles or Rô-soku. The Rô of *Rhus succedanea*, from the southern ports, is almost all that is exported—partly in its ordinary condition, partly bleached.

The bleaching process, which I saw in operation in Uchinoko, in Southern Iyo, was as follows: The raw wax was melted, and allowed to drop through woollen bags into cold water, so as to sub-divide it. Then it was exposed to the sun in little boxes, 2½ feet long by 1 foot wide, on frames. The pieces of tallow need to be sprinkled with water and turned frequently, as in bleaching linen on a lawn. In one of the bleacheries I saw altogether 14 rows of these flat bleaching boxes, on trestles 3 feet above the ground, and in every row 82 pieces. In about 30 days the Rô is white, like bleached beeswax, and almost odourless. Common sumach-tallow bleaches, however, even in closed places, *e.g.*, a bureau drawer, turning white gradually on the surface. But the white rime with which it becomes covered is not very deep.

There is no difference, either external or in composition, between the fat of the lacquer-tree and that of the tallow-tree. Both present solid, brittle masses when cold, with a muscular fibre or grain; both give off a peculiar odour (like wax and grain-soap mixed); both are of a clear yellow-green colour when unbleached. They are harder than wax, but much softer than Carnauba-wax. The specific gravity is 0·916; that of bleached tallow ranging from 0·97 to 1·14.[2] Melting-point is 52°C., but if the stuff is melted again when scarcely yet set, it is 42°C. In 700 parts of alcohol of 97 per cent. and at 30°C. it becomes entirely dissolved.

Chemical investigations have shown that this sumach tallow consists of a mixture of several glycerides, that of palmitic acid predominating. The Japanese use it not only for candles, but in many other ways besides, instead of beeswax—for instance, to produce polish in cabinet-work. With us it is added to beeswax, so as to impart more solidity to the candles, and cause them to come more easily from the mould. It is used instead of beeswax for a similar purpose in some rubber factories.

The exportation of vegetable tallow from Japan began when the country was opened. Its value has been subject to many fluctu-

[1] These cakes of tallow look like lumps of North American maple sugar. They are of different sizes (8 to 16 cm. in diameter, 3 to 6 cm. thick) and weigh from ¼ kg. to 1 kg.

[2] Among several pieces in my possession there is one of 0·75 kg. from Aidzu, which sinks immediately in spring-water, at 15°C.

ations since then, from 106,000 yen in the year 1878 to 377,000 in 1873. England and the United States are the chief purchasers.

The amount exported and its value depend in this case, too, upon the demand. If the demand were to increase, Japan would soon be in a condition to meet it, by limiting the use of candles on the one hand, and also by gathering and utilizing the very considerable quantity of lacquer-tree fruit which now often goes to waste. Besides, the country still has at its disposal great areas in which the cultivation of both species of sumach might be extended, in case it should be advantageous.

16. Ibota-rô, Ibota-wax, from *Ligustrum Ibota*, Sieb. (*L. vulgare*, Thunb.) This is very solid, of a beautiful white colour, fibrous, and with a silky sheen, like the fibres of asbestos. It resembles Chinese Pelah-wax, which is produced by the Coccus Pelah (a kind of cochineal) on the young shoots of *Fraxinus chinensis*, Roxb., as is well known. Ibota-wax is said to result from the secretions of a similar insect. I do not know how it is produced or used, nor have I observed that cochineal insect on the Ibota-privet, which is very widely distributed.[1]

Supplementary.

Thunberg, in his "Flora Japonica," p. 180, remarks, under Melia Azedarach, that a fatty oil of the consistency of wax is made from the fruit, which is ripe in December, and that this is used for making candles. This note has found its way into several later works.

In reference to this, however, I agree with Siebold's remark: "E fructibus exprimitur oleum (Thunb.), id quod ignoro," and am ready to believe that this is a case of confusion with *Rhus succedanea* or *R. vernicifera*, to whose fruit that of Melia Azedarach bears some resemblance, though it is much larger.

Siebold says oil is obtained also from the fruit of *Litsæa glauca*, L., and *L. Thunbergii*, Sieb. (*Tomex japonica*, Thunb.), but I could learn nothing further as to that.

Kujira-abura, whale or train-oil, and Giotô, or fish-oil, are obtained from the animal kingdom. The large number of herring-species (*Clupeaceï*) caught, especially on the coasts of Hondo and Yezo, are utilized for the most part in the manufacture of fish-oil

[1] I take opportunity, though late, to thank Prof. Fesca of Tôkio for the following observations on this subject, collected by his Japanese assistant:

"Ibota-wax is obtained principally in the provinces of Chikuzen, Çhikugo, and Buzen, on the island of Kiushiu, and is brought to market viâ Ôsaka. The total amount from these three provinces is only 2,000 kin (1,202 kg.) a year. The price ranges from 50 to 70 yen for 100 kin. The Japanese use this fat as varnish (?) for their furniture." A small specimen of the raw material, sent me by Prof. Fesca, consists of light, loose lumps of a grey-white colour, which feel like flour.

and fish-guano. To these belong especially the Iwashi, or Japanese sardines (*Clupea melanosticta* and *Cl. gracilis*), and the Nishin *Cl. harengus*). Of the former sorts one can buy 24 to 40 for three half-pence, at Chôshi, for example, at the mouth of the Tone-gawa (see Rein's "Japan," vol. i. p. 189). The fish, as soon as caught, are put into large iron kettles filled with water, and made to boil. The fat floats on the surface of the water, and is skimmed off. Then the residue is spread out on mats in the sun to dry. It creates an abominable smell in the neighbourhood of fishing-villages, but furnishes later a valuable fertilizer, which is carried away by merchants from the larger towns, and retailed to gardeners and farmers in the tea-districts.

(d) *Textile Plants.*

We include under this head all the plants of Japan which contribute in any sense to textile industries, hence not only textile plants proper, but also those which are used in different kinds of wicker-work, as rushes and willows, or in the manufacture of ropes and paper, as many species of bast.

1. *Cannabis sativa*, L., Jap. Asa. This figures as the oldest textile plant of the Mongolian-Tartar races, as far back as the history of hemp can be followed.[1] It has been spread with them far from their old home in Central Asia, eastward across China, Corea, and Japan, and westward, chiefly by the Scythians, across anterior Asia and Sclavic countries. By the Sclavs it was made known to the Germanic peoples, and by them to the Romans, in so far as these had not already made its acquaintance by way of Asia Minor directly. Hemp-smoking, or *Hashish*, was known even then to the Scythians, as we learn from Herodotus, and is still widespread in the Mohammedan countries of Asia and Africa; but was never taken up by the Buddhistic East Asiatics.

Hemp was grown in Japan several thousand years ago, like flax in ancient Egypt. Before silk and wool were introduced, it was the most important for all classes, and for most the exclusive clothing material. An old legend ascribes its introduction to the sublime creative divinity Taka-mi-musubi, who commanded two subject gods to plant Kôdzu (*Broussonetia*) and Asa (*Cannabis*), in order to obtain and utilize the bark of the one and the bast of the other.[2] To this day coarse hemp-yarn is the material of which a considerable part of the country population make their trousers and blouses; and fish-nets and mosquito-nets are made of it. But fine white textures, not much inferior to good European

[1] See on this subject, among others, Hunfalvy: "Die Ungarn oder Magyaren." Vienna, 1881.

[2] See Satow: "The Shinto Temples of Ise." "Transactions As. Soc. of Japan," vol. ii. p. 129.

linen, are also extensively made from hemp, and are called Nuno or Jôfu.

Hemp is cultivated all over Japan, being most frequently found, however, in the mountain valleys and the northern plains, where the cotton-plant does not thrive. Like flax in many parts of Germany, hemp is here raised on small patches of ground, and mostly for home use. Climate and soil are everywhere favourable. It flourishes well even on Yezo, as we learn from Gärtner's reliable accounts, and is without doubt one of the plants most to be recommended to Japanese agriculture in its further extension and development.

When harvested, the hemp-stalks are separated from their leaves and roots, and then soaked in water 4 to 6 days. The loosened bast is then stripped off by hand and dried, as are also the stalks, which look like bare willow rods. They are used for thatching roofs, composing the first layer above the rafters, and are covered in turn by a layer of straw. The Japanese hemp-bast is 1 to 1½ m. long, and of excellent quality, being soft and firm, and having a silky sheen. It might become a prominent article of export if its cultivation were more extensive.

2. *Gossypium herbaceum*, L. This, the most important of all cotton-plants, and the only kind they cultivate, is called by the Japanese Wata-no-ki or Ki-wata, and its product they call Wata. This word recalls the German *Watte*, the French *ouate*, and similar Romanic terms, as well as *badarâ*, the Sanskrit name for cotton. Its derivation from the latter seems more natural than that given by Diez, of *ovum*, especially as the plant has been longest cultivated in India.

According to the oldest Japanese authorities, the first attempts to raise cotton in Dai Nippon were made about the year 799, with seeds brought by accident in a boat from India. But at that time its cultivation did not secure a firm footing, and seems not to have been tried again till 1570. And it only gained a wide extension after the establishment of the Tokugawa regime, in the next century.

The production seems never to have equalled the demand, and China appears to have furnished supplies of raw cotton for home consumption then as in more recent times. With the present freedom of commerce, and the low prices of English and Indian cotton goods, circumstances hardly favour a further extension of Japanese cotton-growing.

The northern limit of its cultivation is somewhere about the thirty-eighth parallel. The Japanese probably became acquainted with it through the Portuguese, and from them learned the name Wata, for they have no word of their own for cotton, nor yet a Chinese term, and the plant itself is thought not to have found entry into Southern China till the eleventh century.

There are three varieties of the cotton-plant in Japan, with yellow, white, and red blossoms. The yellow-blossoming kind much preponderates. Early in May the seeds are planted 3 to 4 cm. apart, in rows that are separated about 40 cm. from each other. The ground is prepared beforehand, and afterwards the seeds are covered with rice-straw ashes. As a rule, however, cotton is planted alongside of and after a winter crop, especially of barley and wheat, a row of cotton-seed being put into the ground —which has been loosened a little for it—close beside each row of ripening stalks. Having been previously softened in water a whole day, they soon sprout. As soon as the first true leaves appear, some strong manure, such as oil-cakes or fish-guano, is added—the latter, however, only in a circular furrow running around the sprout at a distance of 6 to 9 cm., lest the sharpness of the fertilizer destroy the plant. But usually a kind of compost is used, which has been prepared long beforehand, consisting of a mixture of mud, straw-ashes, chopped weeds, oil-cakes, and fish-guano, in equal parts. As soon as the grain-crop has been harvested, the ground is worked over and loosened with great care, and a fresh supply of manure put on, being this time probably made up partly of cesspool stuff. About June 20 the superfluous plants are hoed out, and only 27 or 28 left standing to the ken (1·80 m.). Two weeks later there is another clearing out. During the hottest days (July 20 to Aug. 7) buds come out on the branching stalks. August is the month of blossoms, and harvest is in September. It is considered a good harvest if 300 tsubo (9·92 are) yield 253 kin of cotton (150·261 kg.).

3. *Boehmeria nivea*, Hooker and Arn. (*Urtica nivea*, L.), Jap. Mao, Kusa-mao, and Kara-mushi, Chin. Tschou-ma. This plant is distinguished from all related species of nettle by the fact that its leaves are white on their under side. It grows wild in Cochin China, China, and Japan, but is also cultivated in these countries, and in the southern monsoon region. In its bast it furnishes the celebrated China-grass of the English, from which the Chinese make their fine nettle-cloth. A related species, with higher stalks and leaves green on both sides, is *Boehmeria tenacissima*, Gaud. (*B. utilis*, Bl.), whose bast is called Ramee or Rheea-fibre. It belongs to the tropical monsoon region, and does not occur in Japan. However the bast of China-grass is often called Ramee, as are also the fibres of other Boehmeria species and of the Japanese *Urtica Thunbergiana*, S. and Z., or Shi-kusa.

Boehmeria nivea requires a moist, fruitful soil, and strong manure. Our summer warmth is sufficient for it, as numerous experiments in botanical gardens have long since proved.[1]

[1] Its stalks grew to be 1·31 m. high in the botanical garden at Marburg, in 1877, while stalks of *B. utilis*, Bl. close beside them had grown in the same time 1·90 m. high and proportionately thicker. The former species was introduced into England as early as 1739, under the name of *Chinese* or *White-leaved nettle*.

Like its relatives, it puts forth its stiff stalks from 1½ to 2 m. high, every summer, from perennial roots. These are cut off close to the ground towards the end of August or in September, and subjected to a short soaking in water to get the bast.[1]

There are several special obstacles in the way of a technical utilization of *Boehmeria nivea*, as of certain other nettle species. There has not yet been nearly as much success as might be expected from the great efforts and encouragements to its use, not to mention the exaggerated hopes which many set on such utilization. The first thing necessary is to invent a machine for separating and preparing the bast. The Indian government, in 1878, offered a grand prize of £5,000 for this object, and declared its willingness to furnish Boehmaria stalks from the botanical garden of Calcutta for the experiments, which were to be undertaken in Sahdranpur, India, from the middle of August to the middle of September, 1879. Yet it failed to accomplish its purpose, and the matter fell through.

The epidermis of this plant, however, adheres so fast to the bast-tissue beneath it, that it is extremely difficult to thoroughly separate them. There are a large number of other difficulties besides this, rendering it hard to get the bast clear. Wiesner, in his book on plant-stuffs, pp. 387–393, has dealt with these in part.

Marco Polo makes mention of this white-leaved nettle, remarking that the province of Kweichau is especially distinguished for textures from its bast. This so-called grass-linen is fine, smooth, and shiny, like cambric, besides being very cool, and therefore peculiarly adapted for summer wear. I never observed any cultivation of the Mao-plant in Japan. It is said to be cultivated, particularly in Uzen, Kaga, Echigo, and Idzumo, as was shown at the National Exhibition at Tôkio, in 1877, the official catalogue of which recorded no less than thirteen exhibitors of fibres, ropes, and textures from Yamagata-ken (Uzen), and seventeen from Chimane-ken (Idzumo). This industry is, however, by no means in an advanced and influential stage. The bast ordinarily used is perhaps tough and durable enough, but it lacks fineness. The so-called "cottonized China-grass," on the other hand, consists of white fibres, which compare favourably with flax in fineness and strength, and with silk in lustre.

4. *Musa basjoo*, Sieb. (*M. paradisiaca*, Thunb., *M. textilis*, Nees), Jap. Bashô. The banana is no longer found in Japan proper, though it is extensively grown on the Riukiu Islands, chiefly for its bast, from which the natives make a light, loosely woven brown cloth, called Bashôfu. Of this plant Doederlein speaks as follows:—

"Bananas (on Amami-Oshima) grow almost as high as Cycas, though keeping close to the water-courses, along which they grow

[1] St. Julien's statement in "Industries de l'Empire Chinois," etc., p. 166, "Chaque année on peut faire trois récoltes," is mistaken.

densely. It is as textile-plants that they are cultivated (Manila hemp). Their fibres furnish not only a superior material for ropes and mats, but are universally esteemed for the excellent clothing-stuff that can be manufactured from them. In summer such garments are much preferred to woollen. It is one of the chief exports of the Liu-kiu Islands, and large quantities are sent to Satsuma, whence it may make its way further through Japan."[1] This last is true only to a very limited extent. These textures do not leave Southern Japan, being used in scarcely any other part of the country.

5. *Corchorus capsularis*, L., Jap. Ichibi, Tsunaso, and Kanabi-kiyo. This plant yields jute-fibre, which has become of such great importance. It is found in several parts of Japan. But I doubt whether the plant has been cultivated and its bast made into ropes and coarse textures, as has been stated by one authority.[2] The following four bast-plants are not cultivated. As a source of clothing material it is likely that they played a much more important part in old times than at present.

6. *Wistaria chinensis*, S. and Z., Jap. Fuji (see Ornamental Plants). At the Exhibition of 1877 in Tôkio, there was an exhibit of prepared bast of this plant, as well as textures therefrom, called Fuji-nuno, or Wistaria-linen, from Iwate-ken, Fukushima-ken, Shimane-ken, and Hiroshima-ken, hence both from the North and South-west of the island of Honshiu.

7. *Pueraria Thunbergiana*, Benth., Jap. Kudzu. Young shoots from this abundant plant (see bulbous plants) are boiled in an iron kettle in pieces 1 m. long, and then submitted to longer soaking in running water, till their bast becomes loose, when it is stripped off by hand. To bleach, soften, and divide its fibres, it is pounded and treated with water, and otherwise manipulated. When finished, the fibres are tolerably firm and white, like hemp-bast. They are used for the woof of several kinds of cloth, but only to a very limited extent. The Aino women make threads of them, with which to sew their clothes.

8. *Ulmus montana*, Sm., is, according to the testimony of Böhmer[3] and Scheube,[4] the tree which the Ainos call At and the Japanese Ohio-no-ki. The former manufacture from its bast that brownish yellow stuff of which their clothes, as a rule, are made. It is distinguished more by durability than fineness, and is much worn also by the Japanese of Yezo. The bark of the tree is peeled off in spring, and left to soak a half to one month in water, till its bast is loose enough to come off in long strips. The Aino women twist these into threads, and use them on their looms, whose con-

[1] "Die Liu-kiu Island Amami Oshima." *Zeitschrift der deutschen Gesellschaft Ostasiens.* Band 3, p. 141.

[2] "Le Japon à l'Exposition Universelle de 1878," p. 152. Paris.

[3] "Reports to the Kaitakushi," 1875.

[4] "Die Ainos." "Mitth. d. deutsch. Ges. Ostasiens." Heft 26. 1882.

struction Scheube has described somewhat more fully in the above-mentioned work.

9. *Tilia cordata*, Mill., Jap. Shina-no-ki, called Nibeshi by the Ainos, who make ropes from its bast. I saw it worked into mats in Aidzu. It is loosened from the bark by long soaking in running water, and made pliable by pounding. The bast of *Tilia mandschurica* serves the same purposes.

10. To the plants already mentioned must be added those whose bast is used chiefly in the manufacture of paper, though occasionally also for making coarse garments, a much more general application, however, in ancient times. The chief of these are the various species of paper-mulberry (*Broussonetia papyrifera*, Vent., *B. Kasinoki*, Sieb., and *B. Kaempferi*, Sieb.); also the white mulberry (*Morus alba*, L.), the *Edgeworthia papyrifera*, S. and Z., and the *Wickstrœmia canescens*, Meisn., all of which, except the last, are extensively grown. Further details regarding the nature of their cultivation and the way their bast is obtained come later, in the chapter on the paper-industry.

11. *Chamærops excelsa*, Thunb., Jap. Shuro, or Shuro-no-ki. This beautiful fan-palm usually attains a height of 5 to 6 m. in Japan and a girth of about 0·80 m. It is not indigenous, but is cultivated much as in the warmer parts of China, that is, wherever the evergreen oaks and camphor-laurel grow. Solitary specimens are found on the eastern side of Hondo, near Sendai Bay, in latitude 38½° N. On the eastern side it does not reach so far north, and in the interior, which lies higher, it does not occur at all. Its real home has not yet been fully decided upon, but must be somewhere in the tropical monsoon region.

When the leaves of this palm are over two years old they are turned to account. The whole leaf is divided into narrow strips, from which several articles are plaited, hats and ropes in particular. But the dark brown fibres are principally used. These, as in the case of *Chamærops humilis* in the Mediterranean-region, come out like long lashes on the edges of the leaf-sheaths, and surround the base of the leaves and blossom-cups. These hairy fibres (Jap. Shuro-no-ki), a sort of *Crin végétal*, much longer and softer than the so-called Coir of coco-nuts, are manufactured into ropes, mats, dust-brooms, and brushes, in Japan as well as in China. In Tôkio there are, for example, whole families that support themselves by making Shuro-saiku, *i.e.* fine, small (sai) work (ku) made of the palm (Shuro), which they sell in small shops.

12. *Juncus effusus*, *L.*, Jap. I or I-gusa. This is a rush which is widely distributed in the northern hemisphere, and is gathered and made into mats in several other countries as well, though it has nowhere become as important as in Japan. Many a custom and household usage here is intimately associated with the foot-mats, and other textures made from it. To meet the great demand for this rush, it is regularly cultivated in some parts of the country,

often to a large extent. Its mode of cultivation resembles that of rice, and it is raised in swampy fields, where rice is sometimes alternated with it. It is propagated by means of rhizoma-cuttings. New plantations are set out in early spring. The plants are grown in rows. Harvest takes place in August. By that time the rushes are about one meter high. They are also called Goza-gusa (mat-herb). They are cut off close above the ground, dried, and put under cover till used, when they are moistened and the epidermis is rubbed off with ashes.

On page 415 of vol. i. of this work mention is made of the fact that the size of Japanese rooms, and indeed the whole ground-plan of the houses, is determined by the Tatami, or foot-mats. These are rectangles of invariable dimensions, being 6 shaku, or Japanese feet long (at 30·33 cm. per shaku), 3 shaku wide, and $\frac{1}{6}$ Shaku thick. Rooms are built and distinguished as containing 4, 6, 8, 10, 12, and more mats. These Tatami are made of Wara, or rice-straw, closely bound and braided together, constituting their Toko, or bed; they are fastened at the borders with strips of cloth, and covered and held fast by beautifully-woven rush-mats on the upper side (Omote). The Riu-kiu Islands, Bungo and other provinces of Kiushiu, and above all Bingo, in the Sanyôdô, and the neighbouring provinces are celebrated for their rushes and mats. Bingo-omote are valued most. They are more beautiful and dearer than those of Bungo, but not as strong. The rush from which they are made is here called Tôsô, but in Kiushiu it is called Riu-kiu-I. The cultivation and ultization of the rush, meanwhile, are also carried on in more northern parts of the country, as, for example, in Kaga, where the town of Komatzu and several neighbouring villages are much occupied with this work; and also in Aidzu-taira, and elsewhere. Besides the above-mentioned Omote, there are made of these rushes the simple Goza, ("august seat") a word used for matting which serves either as a seat, or as a cover from rain and sunshine; and also the Seki, or sitting-mats. From these uses the reed is sometimes called Goza-gusa and Seki-gusa.

13. We have already seen that rice-straw is much used in many kinds of coarse fabrics, such as ropes and mats. The mats on which peasants spread their grain and other crops to dry, and dwellers by the sea the various products which they get from the ocean, are made of this material, and called *Mushiro*. Another kind of twisted straw, called *Komo*, is made mostly into sacks for carrying rice, and other purposes. Barley-straw is employed in art-industry, to make fine mosaic-clothing.

Besides rushes and rice-straw, many kinds of reeds are similarly employed, though no doubt far less extensively than in ancient times. Chief among these are the following:—

14. *Typha japonica*, Miq., Jap. Gama. Of this, soft mats are made, called Gama-mushiro.

15. *Scirpus maritimus*, L., Jap. Suge. Hats and waterproof-cloaks have been manufactured from this from the remotest times, as well as ropes for fastening rafters together in hut-building. The former use was known also to Kaempfer, for he writes in "Amœn. exot.," p. 900: "Setz, vulgo Suge. Herba palustris, foliis arundinaceis brevioribus tensis, ex quibus ad albedinem redactis construuntur elegantissimi pilei, quibus teguntur deambulantes fœminæ."

16. The leaves of *Zoysia pungens*, Willd., Jap. Shiba and Iwa-shiba, used to be employed in making the Mino, or old grass-mantles. The long root-leaves of this grass were gathered in the mountain-forests, taken home and steeped in boiling water, then bleached and dried and beaten with mallets, and finally strung close together with threads. Lying one above another like shingles on a roof, these strings of leaves remind one of the way the Maoris of New Zealand prepared their clothes from the much broader leaves of the *Phormium tenax*. These Mino were made from various kinds of reed-grass, too, and from hemp-bast. They are still met with, occasionally, in mountain districts. Waterproof cloaks of oiled bast-paper, and more especially, in recent times, umbrellas, have supplanted them.

17. *Imperata arundinacea*, Cyrill. (*Saccharum spicatum*, Thunb.), Jap. Chi-kaya or Kaya, now utilized similarly, serving also in olden times as a thatch, a use still found in mountainous districts.

18. *Phragmites communis*, Trim. (*Arundo phragmites*, L.). This is a species of sedge-grass, which, together with the related species *P. Roxburgii*, Kunth., the Japanese call Yoshi. It grows in abundance on uncultivated, swampy spots, especially along the canals that irrigate the rice-fields. It is used chiefly for thatching, though also for making Yoshi-dzu, or sedge-mats. Like the species next enumerated, it is planted here and there, in wet soil, for these purposes.

19. *Eulalia japonica*, Trim. (*Erianthus japonicus*, Beauv., *Saccharum polydactylon*, Thunb.), Jap. Susuki. Many a lover of the creations of Japanese art has noticed copies of this beautiful grass, with its digitate panicle. But in recent times we have often seen living specimens of it, for it has proved to be less sensitive than South American pampas-grass, though producing a precisely similar effect when planted here and there on a fine, closely shaven lawn. Besides the simple normal form, it appears also with gaily coloured leaves, sometimes striped diagonally (*Eulalia jap. zebrina*). In its habitat it is widely distributed. It grows principally on the Hara, those extensive grassy mountain-slopes, but in uncultivated spots in swampy lowlands too. Here, and in the fields regularly planted with it, pheasants and snipe love to hide in the thicket made by its dead blades and leaves in autumn and winter, just as they do in common sedge.

20. Wicker-work of more solid wooden material is made of

bamboo-cane (Take), willows[1] (Yanagi), and rattan (To). The first two of these are yielded by the land itself, but rattan, from which the finest wicker-ware is made, and which even plays its part in artistic handiwork, has to be brought from the south, the tropical monsoon region. Of course, like bamboo-cane, it must first be split and cut into smooth strips of a greater or less thickness, before being thus used. To-mushiro (rattan-mats) are made and used much less in Japan than in China. On the other hand, To, Yanagi, and Take, serve in the construction of a number of other wicker wares,—among which we may only note Kôri or basket-boxes, which are useful in many ways. For example, the Yanagi-gôri (*i.e.*, willow-bandbox) is an excellent substitute for a trunk, especially in travelling,—like our willow baskets with lids. The sides of its lid overlap and reach to the ground outside of the lower part of the basket, which is smaller. Great numbers of smaller Kôri are made of rattan. They possess the advantage over our wooden trunks of being more elastic, adaptable, and durable. Those stiff broad-brimmed hats, called Kasa, which protect the head from sunshine and rain, but are far from being comfortable, are sometimes woven of peeled willow-wands and sometimes of rattan or bamboo. And finally there are whole hosts of variously shaped baskets constructed of these two last-named materials. Baskets from the province of Tajima are especially beautiful. They are sent to the baths at Arima, and further still to Kobe, and also exported.

(e) *Dye-plants and Tannic-acids, and their Application.*

Japan has not remained unaffected by the great advance in the chemical production of organic dyes. Since the introduction of artificial madder and aniline-dyes, some of the native dye-plants formerly held in great estimation, both cultivated and wild, have lost much of their importance. But their interest for science is not therefore lost. We wish still to know their manner of growth and how they were utilized. The information that follows here, though by no means exhaustive, is designed to supply this want and perhaps furnish something new.

1. *Polygonum tinctorium*, Lour., Jap. Ai, the dyer's knotweed. This plant is cultivated in Eastern Asia. It was first described in 1790, by Loureiro, in his "Flora Cochinchinensis." It has since early times furnished indigo to a vast region in Eastern Asia, comprising especially China, Corea, and Japan, and belongs to the genus Persicaria, like our commonest kinds of knotweed. From a stout fibre-root, it puts forth many round, leafy stalks, 30 to 50 cm. high, at whose joints or nodes the oval, pointed leaves, and after-

[1] Besides *Salix japonica*, Thunb., there are several other species included under this head, which have not yet been thoroughly investigated.

wards, the blossom-spikes are developed. Its blossoms are odourless, of a red colour, and very similar to several other kinds of Polygonum in their appearance and structure. They come forth in August and September, and the harvest generally takes place before they are fully developed. Chemical investigation has shown that the Indigochromogen, *Indican*, is confined to the leaf-parenchym, in cells, and that the stems and blossoms are devoid of it.[1] The method of cultivating and handling the plant is in accordance with this fact.

The dyer's knotweed is by far the most important Japanese dye-plant. It is from it that the indigo is obtained which is so generally used for colouring cotton and hempen garments. It is cultivated, therefore, over a wide stretch of territory, being found in the plains and valleys of nearly all districts south of Yezo. In planting it, the seed is seldom sown directly in the fields, but mostly in beds, from which shoots are taken and set out in rows. These young plants are 12 to 15 cm. high. If the seed is sown in early spring, and strong fertilizers, such as fish-guano and oil-cakes, are repeatedly applied, they attain this height within two months, and are then ready to be transplanted. In 60 to 70 days more—about the end of July or the beginning of August—the chief harvest commences, to be followed by a second crop, as in the case of clover. And an Ai-plantation, seen from a distance, looks like a clover-field before its heads have burst. When the stalks are about 30 cm. high they are cut off with the sickle, close above the ground. Their upper parts, which have the most leaves, are justly considered of the greatest value; and these, with the leaves, are cut off from the lower stalks, which are dried and then burned for the sake of a highly-prized kind of ashes (Ai-no-hai) thus obtained. The leaves, however, are spread in the sun to dry before the house, frequently on the bare ground, so that the dust of the streets is not excluded. They become thus a dull, dark green, and in this condition are put away in straw-rope sacks for further treatment. This takes 70 to 80 days, differing very considerably in this and other respects from the short soaking-processes by which indigo is obtained elsewhere from other plants. It is a sort of fermentation, and has to be conducted with great attention and skill. The leaves, after being sprinkled with a certain quantity of water, and thoroughly mixed with it, are spread out and left 3 to 5 days, under a cover of mats. The process is repeated 19 to 20 times altogether, and finally the leaves are put into a wooden mortar. Here in two day's time they are worked into a doughy mass of a dark blue colour. From this balls are made, from the

[1] *Schunk:* "On Indian Blue from Polygonum tinctorium and other Plants." "Memoirs of the Lit. and Phil. Soc., Manchester." Vol. vi. (3 Series), pp. 218–234.
See also Flückiger's Report in the "Botanisches Jahresbericht of Just," VII. 2, p. 343. 1879.

size of billiard balls upwards, and in this shape the article appears in domestic trade. This is indigo, with many impurities, as it is universally used for blue dye. Ruri-kon, a dark indigo-brown, inclining to violet or brown, is prepared from Ai with the addition of lime and Aku, the ashes of indigo-refuse. Ten years ago, with the aid of the government, attempts were made by means of sulphuric acid to separate indigo-blue from these Ai-tame (indigo-balls), and to produce an exportable article. But they failed because of the expense of the process. The most valuable Japanese indigo is yielded by the province of Awa, in the island of Shikoku, on the Linschoten Strait.

In the year 1776 knotweed-indigo was introduced from China into England, where dyers learned to use it under the name of Persicaria. But its importation ceased later on when, owing to the increasing cultivation of Indigofera Anil and other species, a better article was furnished at reasonable prices from Bengal and Java.

In 1826 Saint Hilaire, in France, directed attention to the dyer's knotweed. Ten years later great numbers of these plants were grown in the botanical gardens at Montpellier and Paris, from which fresh material was obtained for the numerous experiments undertaken between 1838 and 1840. Botanists, chemists, agriculturists, and manufacturers emulated one another in studying its properties.[1] Their object was to test the plant and its product for agriculture and dyeing. They hoped to introduce into the country a new useful plant, through which its demand for indigo might be supplied. This hope has not been fulfilled. Of the prominent *savans* who took part at that time in this indigo question, may be mentioned Saint Hilaire, Vilmorin, Delile, Chevreul, Turpin, Joly, Baudrimont, Pelletier, and Robiquet.

From the thorough treatise of our countryman, Dr. E. Schunk of Manchester, already cited, I take finally the following memoranda on this subject:

Schunk received from Paris some seeds of *Polygonum tinctorium*, which he sowed in a hot-bed, transplanting afterwards into soil in the open air. Towards the end of summer he got beautiful pink blossom-spikes, but no ripe seeds. When injured by insects or otherwise, the pretty, bright, oval leaves did show blue spots, it is true, but otherwise, even under the microscope, only chlorophyll, and no other colour, was to be seen.

A handful of leaves being chopped up and rubbed fine in a mortar with a little water, and then pressed out, a green, slimy fluid is produced, from which a green, flaky precipitate is separated by a solution of acetate of lead. This precipitate consists of chlorophyll, albumin, and other substances. The fluid thus filtered is clear and yellow. On being mixed with hydrochloric or sulphuric

[1] See, among others, *Turpin:* "Etudes microscopiques sur le gisement de la matière bleue dans les feuilles du Polygonum tinctorium," etc. Comptes Rendus VII., pp. 806–824 (1838).

acid, it gives a rich deposit of almost pure indigo-blue. More colouring-matter is obtained by this method than with an equal amount of woad-leaves, or pastil-leaves (from *Isatis tinctoria*).

Indican, Indigo-chromogen, was produced by Schunk as follows: The alcoholic extract from dried and pulverized Polygonum-leaves was allowed to evaporate till only a brown fluid remained. This he poured off from its sediment and mixed with a solution of sugar of lead. This gave him a muddy yellow precipitate of chlorophyll, and other impurities, and after filtration a clear yellow fluid, to which he added basic acetate of lead—lead-vinegar. The pale yellow deposit thus produced was separated by filtration from the fluid, edulcorated with water and spirits, and dissolved in anhydrous alcohol, and then a stream of carbonic acid directed through it. The fluid after a short time became yellow, and white-lead was separated from it. Then followed filtration and the addition of sulphide of hydrogen, to cause a further precipitation of lead. After another filtration Schunk allowed it to evaporate, and there remained a syrup, which, when treated with ether, yielded indigo.

The qualitative reactions of this indigo-producing stuff are exactly the same as those of Indican from leaves of *Isatis tinctoria*. It is a yellow, transparent syrup, which displays little inclination toward crystallization, and is soluble in water, alcohol, and ether. Its aqueous solution has a more or less acid reaction, takes on a deep yellow colour with caustic alkali, and gives a light yellow precipitate with basic acetate of lead. When the aqueous solution is mixed with a little sulphuric or hydrochloric acid and allowed to stand quiet, indigo after a time separates, sinking to the bottom and forming a scum on the surface, as is also the case with Indican from *Isatis tinctoria*.

Schunk proved by these investigations that neither free indigo nor its hydrate (reduced indigo, indigo-white), but only indican are present in dyer's knotweed, thus disposing of Joly's assumption of the contrary.

2. *Carthamus tinctorius*, L., Jap. Beni, Beni-no-hana, common saw-wort, or the safflower. This is an annual. In its stiff stalk, branching upwards, and its big, round, yellow blossoms, it resembles Inula; in its stemless prickly leaves it resembles thistles, belonging, like both of them, to the great family of the composites, and following Centaurea in system. The plant attains a height of 50 to 100 cm. and yields in its blossoms (separated from the calyx) the well-known safflower, or Spanish red, besides a yellow dye-stuff. India (which is thought to be its original home) and Persia and Egypt have been distinguished in its cultivation from of old, and to this day they supply the world with the greater portion of its safflower. We know now for certain that the saw-wort was raised in Egypt more than 3,500 years ago, since Schweinfurth recognised it in the garland which Brugsch and Maspero, in 1881, found in

the newly-discovered graves of the Pharaohs at Thebes, on the breast of Ahmes II., the conqueror of Hycsos.

From these three countries its cultivation spread over many others, both tropical and temperate climates, even to Germany; but in this century it has declined almost everywhere, and in many parts has vanished altogether. The safflower has been supplanted by cochineal and lac-dye especially, and recently, to a much greater extent, by the aniline dyes.

Japan received it from China. But Southern China and India began to put on the market, and at low prices, a better article than that produced at home, and since then the plant has been cultivated less and less, until now it is hardly worth mentioning. In all my journeyings in Japan in every direction, I only met with it two or three times. It grew in small beds. The object of raising it was to obtain Beni, the favourite cosmetic of the Japanese girls. This is pure Carthamin ($C_{14}\ H_{16}\ O_7$), and a comparison of its mode of preparation with our method may be made from my remarks at the end of this chapter, on dyeing with safflower. It has a metallic, gold-green lustre, reminding one of certain aniline dyes and the sheath-wings of several species of Cetonia and other beetles. The Japanese girls dissolve it in water for reddening their lips. In Kiôto they often put it on so strong and concentrated that the green metallic lustre appears instead of the red colour.

3. *Rubia cordifolia*, L. (*R. cordata*, Thunb., *R. munjista*, Roxb.), Jap. Akane or Beni-kadzura. This is the old Indian madder, which seems to be widely distributed in the eastern monsoon-region, as well as in the Himalayan valleys. I have found it repeatedly in Japan, and always wild, like the following species.

4. *Rubia chinensis*, Reg., Jap. O-kinuta-sô.

5. *Lithospermum erythrorhizon*, S. and Z. (*L. officinale, var. japonica*, Miq., *L. officinale β erythrorhizon*, Maxim.), Jap. Murasaki and Murasaki-kusa. The roots, called Shikon, of this stone-crop, which grows all over Japan, used to serve for violet and red pigments, as in China.

6. *Myrica rubra*, S. and Z., Jap. Yama-momo. Its bark, which is called Shibuki, contains an astringent pigment, which is used to colour and make durable fish-hooks and nets.

7. *Perilla arguta*, Benth., Jap. Aka-shiso. We have already noticed the application of the red pigment of this plant in housekeeping.

8. *Cæsalpinia Sappan*, L., Jap. Suwô. Sapan-wood is not found in Japan, but was formerly largely imported by Chinese as a red dye.

Cochineal, lac-dye, fuchsine, and similar dyes have diminished the value and use of the above-mentioned red pigments in Japan. In like manner auramin and flavaniline, with their excellent qualities and cheap prices, have begun to supplant the remaining yellow pigments.

9. *Gardenia florida*, L. The name Kuchi-nashi is applied both to the plant and to its fruits. The plant is a small evergreen shrub grown here and there for decorative purposes; but it is no doubt indigenous to Southern and Central Japan, and not merely run wild.[1] The prismatic six-edged and six-pointed green calyx grows in together with the germ. Its large white corona stands up like a salver. Six stamens grow on the lower edge of the corona corresponding to its six tips. When ripe, the berry is of an orange-yellow colour, and as large as our common long acorns. It is surrounded by the close-fitting, wrinkled, yellowish calyx, which dries upon it and accompanies it to market. The yellow pigment which the berry contains is said to be identical with the crocin ($C_{32} H_{36} O_{12}$) of the saffron.[2]

10. *Evodia glauca* Miq., Jap. Kiwada and Obaku, a tall tree of the Rutaceæ family (Xanthoxylaceæ group), with a smooth bark, and resembling an ash, in its feathered leaves and its whole aspect. It still occurs pretty often in the remoter mountain-forests of Central and Northern Hondo, in spite of the fact that it is much sought after in summer. Its bark is torn off in great strips and sent to the dying establishments in the great cities. In travelling through mountainous regions, *e.g.* through the peninsula of Yamato and the district of Aidzu, about the Inawashiro Lake, one often meets carriers or pack-horses with loads of this bark, air-dried, and in pieces as long as one's arm. With the exception of its thin epidermis, which is of a brownish colour with light grey spots, it is all yellow, like grated gamboge. The *Ki-iro*, or yellow of silk-stuffs, used to be obtained from this bark. At my instance, Herr Dr. F. Noll junior, while a student at Marburg, made a number of experiments with it, of which I give here the chief results.

a. Of the various solvents that were used, water took up the pigment immediately in great quantity, becoming a deep yellow. With alcohol, the solution was much weaker. With ether it was weakest. The ether remained clear a long time, showing a yellow tinge but slowly. From this it follows that the pigment is not of a resinous nature.

b. The solution in cold water is much purer and a more beautiful yellow than in boiling water, which receives a brownish tinge from foreign substances, such as mucilage, etc., that are also present.

c. The extract obtained through cold water, and also the hot extract, have a neutral reaction.

d. The strong solution of the yellow pigment which is brought about by pouring on water at normal temperature, shows no

[1] For example, I found it in abundance on gravelly soil, in a thin, shrubby forest in Mino, and that too on the road leading from Gifu to Atami via Hino (2 ri) and Kuchinashi, and on hills; so there can be no doubt as to its being met with in a wild state.

[2] Flückiger, "Pharmakognosie." Aufl. 2, p. 735.

change in the amount of its yellow on the addition of caustic hydrate of soda, chloride of lime, or sulphurous acid.

e. Silk and wool, after their *dégraissage*, take up the yellow pigment easily, becoming a beautiful yellow, and the dye holds fast in them when they are washed with soap and cold water. It holds, too, against cold diluted lye, solution of chloride of lime, and sulphurous acid, while hot soda-lye or solution of soap deprives these textures of this colour immediately. Vegetable fibre is not so receptive of the pigment, which is partly washed out at once with water.

Considering the great quantity of beautiful pigment contained in Kiwada bark, it would be well worth while to perform some more thorough experiments with it. These should be directed to ascertaining its nature, and to answering the question, whether the staying power of the beautiful yellow colour might not be increased by using more suitable mordants.

11. *Pyrus* —— ? Jap. Dzumi. The bark of this tree, with which I am not well acquainted, is also said to yield a beautiful yellow.

12. *Curcuma longa*, L., Jap. Ukon. The rhizomas of this plant, or rather the yellow dye prepared from them, are imported from India and China.

13. *Prunus Mume*, S. and Z. The bark, called Ume-kawa, yields a light brown colour, the Shira-cha.

14. *Amygdalus Persica*, L., Jap. Momo-kawa, the bark of the peach-tree, serves in cloth-dyeing to produce the Cha-iro, the tea-colour.

15. To produce *Kuro-iro*, black colours, ferrous acetate and ferrous sulphate are employed in connection with one of the many bodies containing tannic acid. Among these must be enumerated the galls, or Fushi, of *Rhus semialata*, Murr. the fruits of species of alder, Han-no-ki or Hari-no-ki (*Alnus maritima*, Nutt., *A. incana*, Willd., *A. firma*, S. and Z.), the green fruit-hulls of the Kuri (*Castanea vulgaris*, Lamk.) and Tôchi (*Æsculus turbinata*, Blume), Shibu, the juice of *Diospyros kaki* (L. and D., *Lotos*, L.), Kawa, the bark of several different trees, particularly the Kashiwa (*Quercus dentata*, Thunb.), Kunugi (*L. serrata*, Th.). The Budo-nedzumi, a dark violet colour, is obtained by means of Fushi and O-haguro (ferrous acetate). If the latter is concentrated, the result is a black. Kobi-cha, a grey-brown cloth-dye, is obtained from O-haguro and Momo-kawa ; Hiwa, grass-green, from indigo and Kiwada-bark. A decoction of Kariyasu (*Calamagrostis Hakonensis*, Fr. and Sav.) yields a yellow-green colour.

Tannic Acids.

Leather (*Kawa*) was formerly little used in Japan, so-called leather-paper taking its place in most cases. Its manufacture and manipulation, moreover, belonging to the unclean despised occupations which fell to the lot of the Etas, were accordingly not characterized by great results, and tannic acids had less consideration as such than as agents for producing black in dyeing. Of recent years, European habits of dress and systems of armament, in military and official circles and elsewhere, have brought about a change in this respect. Both tanning and shoemaking developed rapidly, and gained an honourable position in public opinion. Side by side with this arose a demand for tanning materials, in which the country abounds. This is now met in great part by oak-bark, particularly that of the Kashiwa (*Quercus dentata*, Thunb.), though that of the Yama-momo (*Myrica rubra*, S. and Z.) is also highly prized.

Two other Japanese tanning principles, however, are of much greater interest and very peculiar. These are universally known by the names Fushi and Shibu, and are much used.

By Fushi or Gobaishi are meant the peculiar galls, rich in tannin, of *Rhus semi-alata* Murr. (*R. Osbechii*, D. C., *R. javanica*, L.). This beautifully-leafed sumach is called Narude, Fushi-no-ki, Kachi-ki, or Yenbuju. It forms a good-sized shrub or small tree 3 to 8 m. high, which is widely spread in the mountain-forests of Japan, as of East Asia in general. The galls are produced in the form of large blisters, of many shapes and sizes, averaging 4 to 5 gr. in weight, 4 to 6 cm. in length, and 2 to 4 cm. in circumference at the thickest part. They are very irregularly shaped, possess knobs and horns, and as a rule hang close to the leaf-stems (seldom to young twigs) with a horn that runs to a point, like the hanging chrysalis of many diurnal butterflies. The ground-colour is brown, though it is visible only in the protuberances, while the rest is covered with a short, dense, felt-like hairs. Stripes are plainly visible about the narrowing basis, gradually fading away towards the thicker parts, especially on the convex side of these singular, many-shaped galls. Their walls are generally about 0·5 mm. thick, though in exceptional cases 3 to 4 times thicker. They are very brittle, translucent, and horny.

These peculiar formations are said to be occasioned by the sting of a leaf-louse (*Aphis chinensis*), like Chinese gall-nuts. They are indisputably of all galls the richest in tannic acid and the most valuable, containing as they do 65 to 78 per cent. of tannin.[1]

The Fushi-no-ki (gall-apple tree) I have seen very often in Japan, but only occasionally its galls. The best come from Shinano. Nasu in Shimotsuke, Chichibu in Musashi, and the provinces of Bingo, Iyo, Idzu, and Kii were mentioned as further sources of supply. The amount sent to market, however, does not greatly

[1] For a more detailed account see under Gallæ chinensis, pp. 246–249 in Flückiger's "Pharmakognosie des Pflanzenreichs," Aufl. 2. A good picture of the plant with a gall is given in part 2 of the eight-volume Japanese work, "Kô yeki koku san kô," (Thoughts concerning the distribution of useful products of the country), by Ôkura (Nagatsune), Ôsaka, 1844.

exceed the home demand, while no less than 20,409 piculs, or about 1,234,000 kg. were exported from China in the year 1878.

A former national custom in Japan—which of late has been rapidly dying out—required married women, and maidens who had got past a certain age and with it the hope of finding a husband, and besides these the Kuge (the court-nobility in Kiôto), to blacken their teeth. This was done with a sort of ink, made on the teeth themselves, and called Ohaguro,[1] Haguro, or Kane. For this purpose they used pulverized galls (Fushi-no-ko) and ferrous acetate, made by pouring diluted Saké boiling-hot over ingots or nails of iron. They brushed their teeth with this solution of iron, and then rubbed them with some of the white gall-apple powder, thus really making ink, which, of course, had to be renewed from time to time.

Shibu or Kaki-no-shibu. This is the astringent juice of unripe Kaki—that is, of certain sorts, called Shibu-gaki. In the "Transactions of the Asiatic Society," vol. ix. p. 36, Ishikawa gives the following description of it:

The fruits of Shibu-gaki—that is to say, Kaki species—preserve their astringent character even till the time of ripeness. Early in summer they are stamped in iron mortars; then the pasty mass is transferred to wooden tubs, covered with water, and allowed to stand half a day. Then it is all put into bags woven out of straw-rope; and a milky juice is pressed out under a simple angle-press. This juice yields the best Shibu, especially if the small fruit of the Shinano-gaki (*Diospyros Lotus*, L.) is used.

By soaking what remains and pressing it again, a second quality is obtained. The milky juice soon takes on a darker colour through exposure to the air, and its surface quickly becomes covered with a thin scum. Shibu as known to commerce is a light or dark grey fluid, in which numerous fine hard particles are suspended. It exhibits an acid reaction on litmus paper, and in a solution of gelatine gives off a great quantity of the usual flaky precipitate of tannic acid. Its odour is singularly disagreeable.

This fluid is used in many ways. It gives toughness to wood, paper, fish-nets, and other objects, increasing their resisting power against many injurious influences. In some Shibu tested by Ishikawa there were 64·4 grammes per liter of solid matter, more than half of which was tannin.

Paper soaked in Shibu receives from it qualities different from those imparted by other tannic acids. The effect (greater firmness, dark colour) is therefore not attributable to the presence of albumin and the formation of a sort of leather. But during the experiments the following facts were brought to light, which indicate an explanation:

(1) Shibu turns black only when it comes in contact with the air, being like Japanese lacquer in this respect.

[1] O, a prefix of respect; ha, teeth; guro = kuro, black.

(2) When exposed to the air in flat vessels a tough skin is formed over it, almost insoluble in water and alcohol.

(3) The first skin being taken off, a new one comes, but much more slowly and weaker, and so on.

(4) Of the substances in suspension, the coarser portion sinks to the bottom, the rest remains diffused in the solution. They appear to be, therefore, a sort of Gummi resinæ; and to this are attributable the formation of a skin and the dark brown colour which articles treated with Shibu always take on, and which seems to come from the oxidation of the gum. The disagreeable odour of Shibu probably proceeds, on the other hand, from butyric acid.

In conclusion we will add to the foregoing remarks on Japanese dye-stuffs a few words on the *application of the Safflower*, and on certain additional contrivances used in dyeing.

Of the two colours which the petals of safflower blossoms contain when dried and pressed into little cakes, the yellow is not used, but the red is highly prized on account of its beauty and the numerous shades that can be produced by it, especially in the Japanese silk-dyeing establishments. In Europe safflower is everywhere considered a fugitive colour; so I was astonished to hear the Japanese boasting not only of its beauty, but of its durability as well. But I soon found abundant opportunities for convincing myself of the latter too, and of learning the process employed in one of the largest dyeing establishments of Kiôto. Apart from mere external arrangements, it was as follows:

The small, thin safflower-cakes of commerce, were covered at evening with as much water as they could take up, and left standing for a night. Next morning the mass thus soaked was poured into a tub and some rice-chaff was added to prevent its sticking together. Then it was trampled upon until kneaded into a stiff paste. This was put into bags made of palm-rope (from Chamærops excelsa), and subjected to the pressure of a heavy angle-press. There flowed off a yellowish, muddy fluid, which contained the safflower-yellow—which was not used.

The residuum was now poured into a tub, mixed with wood-ash lye and water, and once more left standing for a night. Next morning this mixture was again put into sacks, and a brown-red fluid was squeezed out under the same angle-press. This contained the safflower-red, or Carthamin ($C_{14} H_{16} O_7$). It was precipitated by means of Ume-dzu (plum-vinegar, see p. 86), and the muddy fluid above was decanted off. Then the Carthamin was dissolved in hot water and vinegar, and the solution applied directly in making a beautiful Momo-iro (peach-blossom red) in silk. By the addition of Ukon (Curcuma) powder to the solution, the gorgeous Aka is produced—Turkish-red in various shades—which has so often excited the admiration of critics, in Japanese and Chinese silks. The aqueous solution of Kiwada bark is also used, instead of the Curcuma, to get certain beautiful tones, and stuff that has been dyed red in the Aka-solution is drawn through this, while still wet.

From these remarks it will be seen that the method of obtaining and applying safflower-red agrees in the main with our own; and it is to slight variations, at any rate, that the better result is to be attributed.

The Katas, or matrices for impressing the stuffs with figures, are cut in relief out of Hônoki or Sakura (see Woods). In order to keep certain parts white—such as the letters of a name, etc.[1]—various plans are resorted to in dyeing. The most common is to cover with Nori (starch-paste) the spots which are not to be coloured, this Nori having been mixed with *Nuka* (rice-bran), and then dry the piece in the air before dipping it into the dye. According to another plan, thin pieces of wood, such as shavings, are coated on their under-side with Funori (sea-weed glue, of *Gleopeltis cotiformis*, Harv., and other species), and on their upper-side with paper, and then sewed fast to the spots that are to be left uncoloured.

And in the art, much practised in Kiôto, of painting flowers and other objects on prepared silk fabrics, the plain part is covered with Nori, after the picture has been outlined, to prevent the dyes from overflowing in consequence of hygroscopic or capillary attraction.

4. Cattle-raising and Silk-growing.

(a) *Cattle-raising.*

It will suffice if we here add a few supplementary remarks to the scattered opinions already given in preceding sections, as to the slight importance in Japanese agriculture of cattle-raising on a large scale.

The Japanese horse, or Uma (pronounced M'ma), belongs to the Mongolian breed, is of small stature, with thick head and belly, trots loosely, and gets in a sweat quickly, but shows considerable endurance otherwise. It seldom receives careful attention. It stands in its stall with its head toward the entrance, and is tied with cords to the corner posts right and left, so close that it can scarcely move, and, above all, cannot lie down. There are no mangers or other fixed arrangements for feeding. On the other hand, its quarters are kept very clean. Its feed consists, as a rule, of coarse hay, damped, and mixed with a little bran or groats, and given it in a feed-box, which is usually tied to it while it eats. Besides this it gets barley, and, as a tit-bit, perhaps a handful of beans.

The hay here spoken of is Ma-gusa, *i.e.*, horse-plant dried. It is made from the grass of the Hara; preferably, however, from two papilionaceous shrubs that grow there—the Hagi (*Lespedeza cyrto-*

[1] The peasant, for instance, wears his name in white on a blue blouse; and the Samurai, his name or coat of arms on the back and sleeves of his garment.

botrya, Miq., and other species) and the Kudzu (*Pueraria Thunbergiana*, Benth.). It is mown with the sickle—enough for the slight demand—and brought home on the backs of men and horses, and then spread out before the house to dry in the sun. It is turned with sickles or poles, but never with rakes.

The horse has hitherto been used mostly as a beast of burden, and only secondarily for riding. As a draught-animal it has had no place at all, except in ploughing; for the few heavy Kuruma, or wagons that existed, *e.g.*, in Kiôto, for the Mikado and the Kuge, or for the goods-traffic between Kiôto and Ôtzu, have been drawn by oxen since far-distant times.

Marion in his day remarked that he saw only stallions in Yedo, Yokohama, and Nagasaki. If he had penetrated farther into the country, he would have found districts where only mares were used as beasts of burden. This was because there was no castration, and stallions are so liable to become unmanageable in the presence of mares; so the old regulations arose, separating pack-horses and riding-horses according to sexes and by districts.

Asses and mules were unknown.

Cattle, Jap. Ushi (O-ushi or Kotoi, the bull; Me-ushi, the cow; Ko-ushi, the calf), were formerly kept only for carrying burdens, drawing the plough and the few wagons in use, but never for their milk and flesh. The breed is large, well-built, and capable of being fattened, with high withers, tapering back, and predominant black colour, with a shimmer of brown—a colour like that of the Hungarian and Podolian cattle of the Steppes. The cows, as with that race too, have small udders, and resemble it also in that their milk belongs exclusively to the sucking calf, and dries up as soon as the calf is weaned.

Goats (Hitsuji in the Chinese zodiac) and sheep (Rashamen and Menyô) were formerly quite unknown. They are said to have been brought into the country at different times and mostly by the Portuguese and Dutch, but have not spread. I do not know whether the attempt on the part of the government, in the last ten years, to introduce sheep-raising, has met with much better success. However, I must not fail to mention that Gaertner expressed the opinion that the soil and climate of Japan were ill-adapted to sheep-raising, because the fodder they produce is too long and juicy, and that all attempts hitherto made to domesticate sheep have failed for this reason. As to the unfitness of the soil, I have my doubts. But in view of the fact that sheep-raising succeeds best in countries with a dry climate, the chief obstacle to it in Japan is more likely to be in the damp atmosphere and frequent summer rains.

Swine (Buta), so highly esteemed by the Chinese, and brought by them to Japan, were not bred much here before the opening up of the country and the increased demand for their flesh on the part of foreigners; and even still they are found only in the vicinity of the larger towns. Formerly the inhabitant of the country districts got a roast now and then by the chase, and in that way alone,—except when he caught wild birds, such as ducks and pheasants, or even jays and ravens—the game being mostly wild swine, which were plenty (*Sus leucomystox*, Tem., Jap. I), stags (*Cervus Sika*, Tem., Jap. Shika), bears (*Ursus japonicus*, Schl., Jap. Kuma), apes (*Inuus speciosus*, Jap. *Saru*), and several other animals. Apart from this his animal food was limited to the products of domestic fishery, and a few eggs.[1]

The domestic fowl (Tori, *i.e.*, bird; On-dori, the cock; Men-dori, the hen) is the only poultry to whose breeding the Japanese are universally devoted, and of this they raise various breeds. The tame duck (Ahiru), on the other hand, is as scarce as in Germany, and the goose is unknown.

Dogs, cats, rabbits, white and coloured mice (and also rats), which must be counted among the domestic animals of Japan, are kept almost exclusively as pets. The cultivation of honey-bees (mitzu-bachi) is very limited and conducted with little care. A substitute for their wax, as we have already seen, is the vegetable tallow from the fruits of two species of sumach.

I turn finally to that one of the domestic animals of the Japanese which although more helpless and insignificant than all the others, is yet more important and valuable than these all put together—the silkworm. For, farming excepted, it is of the very greatest importance for the prosperity of many millions of the land's inhabitants. Hence, in the following pages, we give it and its product the more detailed consideration which their importance demands.

(b) *Silk-growing.*

Of all the articles which China and Japan export to other countries, raw silk and silken fabrics are in many respects of first importance. Not only do they represent the highest money value, and contribute most toward increasing the prosperity of these two nations, but the trade in them dates farthest back, and has steadily increased in extent, despite many changes, ever since Roman merchants[2] opened it overland, and Portuguese 1,500 years later by sea. And to all appearances this great eminence will be maintained by silk in the future also, against all the competition of wool on the one hand and cotton on the other. The production of raw silk and of silken yarns and fabrics forms one of the corner-stones of the national well-being of great empires and of existence itself for

[1] Details on this subject, as well as concerning the Japanese fauna in general, are to be found in the first volume of this work, pp. 175–210.

[2] Silk undoubtedly found its way into West Asia many centuries earlier, for it was the material of the Persian and Median garments, so often celebrated by Greek authors. Yet Roman merchants were the first Europeans that penetrated into Central Asia on the so-called silk-roads, at the time of the Empire, to make better roads for this much-prized article.

millions of their inhabitants, not only in East Asia, but in Europe also.

If strength and fineness combined are desired in a thread, we resort to silk, and if warmth is desired for any part of the body, silken cloth comes into play, since it does not offend through coarseness nor become a burden by its thickness. Yarns and cloths made of silk are at once glossy and smooth, fine, firm and lasting, healthy, warm and light. Because of these numerous advantages the use of them has spread more and more in all classes of society, as their price has fallen and general prosperity increased. The yearning for a silk dress has become a common desire of the female sex, and whoever cannot satisfy it, rejoices at least in a silk ribbon, to which, as to the dress, an added brilliancy is given by the aniline dyes of modern times.

History tells us that at the time of the Emperor Aurelian (270 A.D.) silk was worth its weight in gold, and that James I. of Scotland, in 1406, borrowed a pair of stockings, so as to receive the English ambassador with proper dignity. This shows, on the one hand, that this noble stuff was held in due honour many centuries ago and at different periods, long before there was any thought in Europe of raising its old Asiatic companion, cotton, to such an influential position. On the other hand, however, we may conclude that the carriage of silk from East Asia was very expensive, and that its culture in Europe, for a long period, made but slow progress. For it had to contend with difficulties of a peculiar nature. The other textile fabrics—wool, cotton, flax, hemp, etc.—are products of larger animals, or of plants whose character is easily studied, which do not demand very laborious attention, and from which one is sure of a crop in a few months. For silk, however, we are indebted to a little insect, which depends for its life upon a definite genus of plant. Two organisms must here be brought into harmony, one of which, the plant, requires a development of several years, at least, before the other, the silkworm, can begin its life-work; therein differing widely from our other domesticated creatures. The silkworm is exceedingly choice in its diet, and yet has not the means, while in captivity, of making its own selection. It possesses no voice to tell when it is hungry, or cold, or otherwise in need, and yet it succumbs very quickly to deleterious influences, for its life is short and therefore delicate. To learn what is advantageous for it, and to shun all injurious influences, demands close observation, and much circumspection, care, industry, and experience. A single oversight in its cultivation, neglect of the task for but a few hours, sometimes robs the silk grower of the reward of all his previous trouble and labour.

Not only the silkworm (*Bombyx mori*), but also its food-plant, the white mulberry (*Morus alba*, L.), had to be brought from East Asia. Under such circumstances it is easy to understand why silk-culture advanced but slowly in Europe, from east to west, and northward from the Mediterranean—the more so as every innovation has to contend against prejudices, especially on the part of a conservative peasantry. Even such a clear-sighted man as the minister Sully, for example, could not comprehend how such an insignificant insect as the silkworm could really be of any use to France, and it was not without reluctance, therefore, that he carried out the commands of Henry IV. to provide for the establishment of silk-culture.

The cultivation of silk, as of tea, had its rise in China, and spread from thence to Japan. But it has undoubtedly a far greater antiquity, for it is referred to in ancient Chinese records, as well as in the Old Testament and in the Greek classics,[1] from Herodotus. W. Williams[2] states that according to the oldest mythological accounts silk-culture began about 2600 B.C. At that time, they say, the Empress Lui Tsu, in Shan-tung, began to raise silkworms and make fabrics out of their webs. She was afterwards worshipped as the goddess of silk, under the name of Yuenfi, and in the palace at Pekin a temple was dedicated to her, in which to this day the Empress of China, as protectress of silk-culture, annually offers homage to her, and brings certain sacrifices in April, at the beginning of the year's breeding.

"The word by which the Chinese designated silk, migrated with the article, and we find it mentioned at a very early date by this name or others derived from it" (Von Richthofen). The Corean *sir*, the Greek *σήρ*, and our various expressions, are derived from *sz'* (also *ssu*, *sée*, and *sse*), the Chinese term for silk, and the affix *orr* (*'r*). The Serian (?) stuffs come from the Serians, in the land of Sera, from which also originated the word Serica, as a name for China. According to Von Richthofen, the present city of Khotan represents the Issedon Serica of Ptolemæus. Thither in former times silk culture had been transplanted from the Chinese Orient. And by Sera metropolis he meant the Chinese city of Hsi-ngan-fu. Tshang-ye, the present Kan-tshóu was the great silk emporium of more recent times, when, according to Procopius, two monks (Nestorians) brought silkworm eggs to the Greek emperor Justinian from the land of "Serida." From time immemorial the minister Yu (later Emperor Yan) is mentioned as the most prominent promoter of silk-culture. He planted the hill-country of Shansi with mulberries.

Silk is now produced in every province in China, particularly in Che-kiang, Kwang-tung, Sz'tshwan, Hōnan, Kiang-su, and Kwéi-tshóu. The best silk comes from the province of Chĕ-kiang, especially its north-west corner, though even this does not equal Italian or Cevennes silk. It appears from the statistical table that China still stands first amongst the silk-producing countries of the

[1] See in particular the interesting remarks on this subject in v. Richthofen's "China," i. 443, and Yule's "Cathay," 159.

[2] "The Middle Kingdom," ii. p. 39.

earth, and the amount exported annually from it to Europe, North America, and Bombay is between 52,000 and 85,000 bales (of 100 kg.).

The introduction of silk-culture into Japan is recorded as taking place in the second half of the third century (289), and is attributed to Corean and Chinese immigrants. It found a footing and extended contemporaneously with Buddhism. Several legends, however, assign quite another origin, giving a much earlier date. The best known of these informs us that an Indian Princess was committed to the waves of the ocean in the hollowed trunk of a mulberry tree by her cruel step-mother, who had already made several attempts to get rid of her; and the waves washed her to Toyoura on the coast of Hitachi. Here she was kindly treated by the inhabitants, and in gratitude for their treatment was transformed into a silkworm after her death.

For the planting of mulberry-trees and silk-culture generally, the Japanese are especially indebted to the twenty-first Mikado, Yuriaku Tennô (457–479 A.D.), and also to his Empress, who gave in this respect a good example to court and people. And from that time, too, foreign immigrants had to pay their duties in silk. But it was not until the second half of the sixth century and thereafter that silk-culture became fairly established and extended as a national branch of industry.

It has retained the attention and interest of the rulers of Japan, even in the altered circumstances of modern times. The reigning Mikado on more than one occasion has attested his fondness for silk-culture and the products of silk-weaving; and this explains the fact that the Japanese court chooses for presents chiefly home-made silk stuffs.

Silk-culture, like tea-growing, has experienced a revival in the last thirty years. The chief cause of this was the high prices which were paid for raw silk and silkworm eggs, in consequence of the silkworm disease raging in Europe. Though these prices have sunk again, the increased exportation of the former still continues. Silk will probably remain in future the principal article of commerce of Japan, and more than any other afford support and labour to many a poor valley.

As compared with China and Japan, the other Asiatic silk-raising countries play no great part. In India the production of silk, if it has not fallen off, has at any rate remained stationary; and the general decay in Persian and Turkish countries has already, to a great extent, embraced also the principal industry of many districts, silk-culture. Nowhere in the silk-producing countries of Europe did it receive from the above mentioned state of affairs that new impulse which was so effective in Japan.

In Europe, the Greeks first became closely acquainted with silk through the expedition of Alexander the Great through Persia to India. His general Nearchos, according to Arrian, clothed himself in this costly material, and Alexander sent silk-worms to his teacher, Aristotle, who is the first to describe them. But the introduction of silk-culture was reserved for a much later time. Every school-boy knows the story. Two Nestorian monks, as Procopius relates, brought some eggs of the silk-spinner from Khotan to the court of Justinian (550 A.D.) in their hollow staves; the caterpillars produced from these were then fed with leaves of the black mulberry tree (*Morus nigra*, L.), which, though unknown in East Asia, had long been grown in Western Asia, its probable home, on account of its fruit.

Italy, for a long time the foremost silk-producing country of Europe, was comparatively late in learning to cultivate the silk-worm. It was introduced in 1130 A.D. through King Roger II. of Sicily. He brought it from Greece after a glorious campaign against the Byzantine emperor Emanuel, and with it Greek silk-worm breeders, spinners and weavers, whom he compelled to settle in Palermo and benefit his subjects by teaching them their art. From Sicily silk-culture spread to Calabria and northward over all Italy, but so slowly that it was not introduced into Milan till the middle of the sixteenth century. Lombardy is now the chief seat of the Italian silk-culture. Of the 40,000,000 kg. of cocoons (equal to 100,000 cwt. of raw silk), valued at 170,000,000 lire, which Italy produced in 1857, Lombardy alone yielded 15,000,000 kg. equal to 37,500 cwt of raw silk.

The Iberian peninsula became acquainted with silk-culture long before Italy, in the eighth century, through the Arabs.

Its introduction here and from Greece into Italy is attributable to wars of conquest, and in like manner France owes to a war her first mulberry-trees and silk-worms. After the conquest of Naples by Charles VIII. in the year 1440, some French noblemen brought them home with them. But in France, too, silk-culture developed so slowly that the Lombard weavers, whom Louis IX. and Francis I. imported for the establishment of the silk industry in France, had to obtain their raw material from Italy and Spain. Under Charles IX. the mulberry plantations became more and more extensive; but the silk industry and silkworm breeding did not find a really firm footing till Henri IV. took a lively personal interest in them, giving his subjects a notable example of circumspection and perseverance in this matter. The luxury displayed by the court of Louis XIV. together with the high honours which were held out to successful silk manufactures, on Colbert's suggestion, were powerful means for the stimulation of the silk industry; and yet at that very time silk-culture suffered a visible decline and was only able to furnish a fifth part of the 6,000 cwt. of raw silk which the French industry then consumed. It experienced a revival under Louis XVI.; before the Great Revolution the annual crop was 6,500,000 kg. of cocoons (about 1,500,000 kg. of silk). The Revolution reduced this to 3,600,000 kg. of cocoons, but after that the amount rose and the cultivation spread pretty steadily till the year 1853, when it reached the maximum yield of 26,000,000 kg. of cocoons. In the period between 1840 and 1860 the annual production of raw silk in twenty-eight departments of Southern and Central France is estimated to have been on an average, 40,000 cwt., worth 100,000,000 francs. Then came the devastating silk-worm disease, and reduced the yield in the year 1865, to 34,000,000 francs, and in the Cevennes even to one-twentieth of former harvests. The effect of this disease on the prosperity of the people and the value of land was especially marked here, where, for example in the Département du Gard, the best raw silk is made, for the strongest links of fine textures, and a Hectare planted with mulberry trees was worth 20,000 francs, with a yearly yield of 1,200 francs.

We must regard the Alps as the northern boundary of successful and important silk culture in Europe. All attempts and efforts on the part of princes, private persons, and associations to extend it over the countries of central Europe have not yet sufficed, in spite of small successes, to secure for it a footing there. There are plenty of old, moss-covered mulberry trees here and there throughout Germany, and mulberry hedges along railway embankments and elsewhere—the marks of these vain endeavours. These experiments began in Brandenburg, when the Huguenot immigrants introduced silk-weaving. Frederick the Great encouraged it, and sought to promote silk culture by setting out millions of mulberry trees. In the year 1784 there were 14,000 pounds of raw silk produced in his land—an amount which has never been reached again in all Germany. Although Germany now possesses a flourishing silk industry, all the raw material, as in the case of Switzerland, England, and North America, is obtained directly or indirectly from abroad, from Italy and the Orient.

Having taken this short historical and geographical glance at the extension of silk culture, let us return to Japan, to the land whose industry and commercial conditions it is the object of this excursus to illustrate from every point of view, and which, as a silk producer stands second only to China and Italy in importance for our European industry. But before taking up its silk culture in detail, we must, of course, first consider briefly its fundamental elements—the mulberry tree and the silkworm.

The white mulberry tree (*Morus alba*, L.) Japan. Kuwa, like the silk-spinner (*Bombyx mori*, L.) which feeds upon its leaves, has been divided by a high cultivation into many sub-species. But notwithstanding many assertions to the contrary, it has never yet been discovered in a state of primitive wildness.[1] It may be taken

[1] Even good botanists sometimes are in doubt, when they find cultivated plants that have run wild, whether they have not discovered an original home and the pure, natural form of the plant. How much more liable to err, then, is the tyro. Therefore, although Oppert, in his book on Corea, states that the

for granted that its general botanical character is already known. But in refutation of one widespread error, it is well to remark here that some varieties of this "white mulberry" bear black fruit, but are always to be distinguished from *Morus nigra*, L., by their leaves, which are a lighter green, and thinner and more delicate.

The tree accommodates itself to different climates and soils, and on this account, and for its importance in silk-culture, is widely distributed. Thus we meet with it in Europe, from the shores of the North Sea and the Baltic to those of the Mediterranean, sometimes only singly, and again in greater numbers, the last more frequently in proportion as the use of its foliage has become important.

Reproduction can take place by means of seeds, cuttings, and shoots, though one of the last-named methods is chosen as a rule. Melioration by grafting, or budding, does not take place. The plant has a rapid growth, and if it is headed after the manner of willows, puts forth every year thickly foliaged stout shoots more than a meter long. In any one of its usual forms it attains an age of 40 to 60 years, but is generally renewed in 30 to 40 years. In sub-tropical countries, as in Syria and Andalusia, the new leaves come out in March; in Provence and Northern Italy, and also in Japan, in April; in Germany, not till May. Of the various sub-species I found in Japan:

(*a*) *M. alba laciniata*, Hort., with which must be placed *a vulgaris indica*, D.C. (Prodromus XVII. p. 238, ff). It has deep-lobed leaves, is called Tô-kuwa, and found principally in the higher valleys.

(*b*) *M. alba macrophylla*, Hort.

(*c*) *M. alba Morettiana*, Hort. with large, bright, smooth leaves, which are heart-shaped, pointed, and sharply dentated, and less frequently lobed. This, as is well known, is the principal species in Southern Europe.

(*d*) *M. multicaulis*, Perr. (*M. Constantinopolitana*, Lam.) with large heart-shaped leaves, somewhat hairy on their under-side; is planted principally in the plain and hilly country of Japan, and treated mostly as a bush.

As regards treatment, three kinds of cultivated mulberry-trees are found in Japan:

1. *The shrubby* (Hiku-kabu, *i.e.* low stump). This is the kind most carefully and extensively cultivated, and predominates in the more level parts of the great silk districts. The mulberry shoots are set out in soil that has been thoroughly and deeply worked, two-thirds of a meter apart, in rows 1 meter apart. Every year they are cut down nearly to the ground, like osiers. The head or stump thus formed puts forth annually a great number of shoots

mulberry tree and the tea-shrub also, grow wild in that country, the statement stlll needs to be verified by some one qualified to speak on the matter.

(whence, probably, the name *M. multicaulis*, Perr.) with large, strong leaves, which are stripped from the switches either on the spot or at home. The latter is usually the case. At a little distance these plantations do not look unlike a vineyard in level country, especially in the Mediterranean region, without supports for the vines.

2. *The limited tree-shaped* (Taka-kabu, *i.e.* high stump). In this branch of the industry actual stems are obtained, as in raising willows for barrel hoops; but these trunks are headed at a height of 1 to 2 meters. This is mulberry-culture as practised, for example, in Northern Italy and Spain particularly (with *Morus alba*, L., *a*, *vulgaris Morettiana*, Jacq.). In Japan it is especially common in hilly regions, but does not afford so fine an appearance as in Northern Italy, where it is carried out with more regularity and attention. As we see here, it admits of other plants being raised alongside of it, and this is also the case in Japan if the trees, as is commonly the case, are placed wide apart, or on the borders of the fields.

3. *The free tree-shaped* (Taka-gi, *i.e.* high tree). As already remarked, this is most frequently *M. alba*, L., *indica*, and is most frequent in valleys, or rather on their slopes. Owing partly to their situation, and the poverty of their owners, these trees look somewhat neglected. They seldom become more than 30 to 40 years old, and rarely exhibit a finely shaped crown. Manure, of which they require more than the better situated trees and shrubs in the plain, is seldom applied to them.

All silk, Jap. Kinu, originates in the cocoons or pupa coverings of a group of moths which are designated by the name of Bombycides, or spinners. Of these, the *Bombyx mori*, L., the mulberry-spinner, is the best known and by far the most important. To it all the foregoing observations directly apply, and, as a rule, this is true of all remarks on silk and silk-culture. As in the case of our other domestic animals, and many cultivated plants, their culture, lasting for thousands of years, has gradually resulted in the production of a large number of species. These differ from one another in all their stages of development, as eggs, caterpillars, cocoons (pupæ), and butterflies, but especially as to the length of life, size, and form of the caterpillars, and also the size, form, and colour of the cocoons. Almost all of them are characterized, in the caterpillar stage, by a lazy, sociable life, four castings, and the fact that they feed on fresh leaves of *Morus alba*, L. They are thus grouped:—

(*a*) Season-spinner breed, Ital. Annuali, Jap. Haru-ko, i.e. spring-children. They breed only once, in spring and early summer, and produce by far the greatest quantity and best silk.

(*b*) Breeds that fly repeatedly, Zwei und Dreispinner, Ital. Bivoltini and Trivoltini, Jap. Natsu-go, *i.e.*, summer-children, with several changes of breeding in one summer. They are not much valued, and but seldom cultivated.

In both of these chief breeds there are, again, a number of subdivisions, distinguished, according to the colour of the cocoons, as white-spinners (Jap. Shiro-ko, white children), green-spinners (of a yellow-green colour, Jap. Kin-ko, *i.e.* gold-children), and yellow-spinners. White and green spinners are the favourite Japanese breeds, one being preferred in one part of the country, the other in another. Their cocoons, Jap. Mayu, are smaller than the European and Levantine. There are 850 of the white Japanese in a kilogram, and 550 of those raised in Asia Minor; while of the beautiful yellow cocoons of the North Italian Brianza breed it takes only 500 to a kilogram.

In their other stages of development as well, the Japanese white and green-spinners are distinguished by several features from our European breeds. The eggs, Jap. Tane, seeds, French *graines*, have for example, very fragile shells. For this reason the butterflies are made to deposit them on boards (tane-gami) made of bast paper. These are usually 35 cm. long and 22 cm. broad, and are covered with about 25 grammes *i.e.* 45,000 separate eggs. These stick fast, and from them the young grubs creep out on the cardboard. The peculiar character of these grubs is not shown till after the third casting: yellow eyes, with black arches, and plain distinct, dark sickles or half-moons on the back. After the fourth casting they grow very fast, acquiring at this point the appearance of our old breeds, though they remain one-fourth smaller than our yellow-spinners. And the Kaiko or Japanese silk-worms are less active, and have a strong inclination to spin themselves in on the spot where they lie. Until the second or third casting, they must be fed on chopped leaves, which are given them, as a rule, four times a day. In fewer cases it is customary to feed them five or six times, especially in the first two of the five periods into which the caterpillar's life falls, on account of its four changes of skin.

The silkworm, to develop well and strong, needs a clean, dry room, free from draughts, and with fresh, healthy air,—not much exceeding the limits of 10–30° C.,—besides protection from direct sunlight, and clean, fresh food, free from dust, yet dry. The skilled breeder must industriously study all these life-conditions in connection with a number of other smaller, but no less important, circumstances—among them the cleanliness of the attendant—and, through no lack of attention or care, fail to fulfil them. In Japan most of the work falls to the women. The breeding (of Haru-ko, or spring-children) depends, of course, upon the appearance of new foliage on the food-plant, and commences, in the plain and the warmer hill-country, at the beginning of May, but in the valleys not till the middle or end of the month. It lasts, on an average, 34 days, with natural warmth, *i.e.* a temperature varying between 8° and 28° in the shade. In the breeding room, however, an average of 10–20° C. is maintained.

The artificial temperature of 20–25° C. maintained at most breeding places in Europe shortens the time of the Japanese breeds to 32 days, and that of the Brianza to even 25 days.

Silk-culture in Japan is confined to Hondo, the largest of the islands. It constitutes here the most widespread and important home industry, in most cases being carried on in connection with other agricultural employments; but as a rule it is the inhabitants' chief source of income. Where it is carried out to a large extent, one perceives from the large, clean houses, and their beautiful mats, how it has improved the condition of the people. No other branch of agricultural industry gives evidence of an equally beneficial influence. In such districts there are, as might be supposed, particular places in which the caterpillars are raised in larger quantities. In some narrow valleys people even give up the ordinary one-storied style of house, and added another storey to the dwelling below, so as to have plenty of dry, airy rooms for the silk-culture. I have noticed this, among other places, in the province of Kaga, near Ushikubi. Wherever, on the other hand, the breeder, through poverty or neglect, does not give his silk-worms a room by themselves,—wherever at my entrance I met an offensive odour and a swarm of flies, as in many of our cattle stalls, there I also observed signs of ruinous disease (the Pébrine not excepted). Thus, at a single change of bed, hundreds of dead silk-worms had to be cast into the water that ran past—as, for example, in the northern part of Mino. Like the hatching rooms, also the storage arrangements are varied and suited to the means at command—from the simple frame or sieve, to the solid structure of a high stand with compartments. This may be compared, as a rule, to two ladders standing vertically opposite each other, across the rounds of which, at intervals of 25 to 40 cm., are placed the horizontal hurdles or beds, consisting either of parallel laths or bamboo sticks, laid from 1 to 3 cm. apart, and covered with thin straw mats.

When the time of hatching draws near, the paper boards are brought into the hatching room, or to a shady spot in the open air, with the eggs, which have been kept up to this time in a dry place, wrapped in paper and protected from mice. Here the silkworm is developed in the egg gradually, as the warmth increases. Exact observations in Europe have shown that this development begins at a temperature of 10° C., requiring from that point onwards a total heat of about 400° C., which is divided over 24 to 30 days of April and early May, according to their temperature. It is manifest, therefore, that hatching is hastened by artificial heat, increased gradually, but not above 25° C. When the worms appear, they are from time to time and in various ways, transferred to the beds, which have been covered with delicate chopped leaves. This removal is performed either by gently striking the under-side of the cards, or stroking with a feather, or by laying over the eggs a sheet of paper, punctured here and there, and bestrewn on the top side with tender mulberry leaves. The worms that have crawled out, get to the food through the holes in the paper, and can easily be carried off with it the hurdles.

If the breeding is carefully conducted, the bed must be cleaned daily, except during the times of casting, The cleaning is done before a fresh supply of food is given, and, as a rule, in the following way. Above the bed is stretched a thin net (Ami) of hemp-yarn. On this fresh leaves are laid, to which the worms crawl over. Then the straw mat beneath, with its remnants of food, droppings, and possibly dead worms, is withdrawn and cleaned, or replaced directly by another with fresh food. I also saw people carry with their fingers to the new bed the inert worms which had remained behind; but it is better to place them on special hurdles and tend them there, for their languor is often only the first sign of sickness, and it is therefore important that they should be separated from the healthy worms as soon as possible. And it is a point in careful breeding to keep together worms of the same age and condition, which go through their castings simultaneously, and finally spin themselves in and go into the chrysalis stage at pretty much the same time. On this account worms that are hatched a day earlier or later than the great majority, are separated from these and tended on special beds.

On the other hand, it often happens that a breeder begins with a second or even third series of worms a week or two after the breeding has begun, if he still has seed and plenty of food at hand. After the third, and especially after the fourth casting, the worms grow rapidly, and must be separated and put on more beds, so as not to lie too close together, or perhaps even on top of one another. This is best done at the last bed-cleaning before the castings, so that after the third casting there shall be 80 to 100 worms to a square foot of bed. When the change of skin (Jap. Neoki-tsuru; French mue) is drawing near, the worm stops feeding, and becomes somewhat brighter and smoother, and translucent; its head swells; it raises itself up with its head on high like a sphinx, in this position falling into a sick lethargic state, a sleep in which it must not be disturbed till the casting is over. When its development is healthy and normal, this lasts one day. Then the worm turns to its food with new and strengthened appetite, its capacity being much increased. With the Japanese breeds the first and fifth period of age are the longest, each of them lasting eight days, and each of the others averaging six days. Of 300 kg. of food, which 20,000 worms require for their development, more than three-fourths is devoured between the fourth casting and going into the chrysalis state. Their growth and increase in weight correspond to this astonishing requirement of food. Nitrogen alone has formed 14 per cent. of a worm's weight.

The following table will give some information as to the relative weight of the worm at the end of its separate periods of existence, and also of its transformations.

The quantitative changes of the live and dry weight of the silk-worm during its development.[1]

1000 specimens of the Japanese white-spinner gave :—

	Live weight	Dry weight	Relation of the Live Weight.	Relation of the Dry Weight.
	g.	g.	The weight of the worm when just hatched = 1.	
Just hatched	0·414	0·098	1·	1·
1. Period, after 175 hours . .	4·734	0·752	11·4	7·7
2. Period, " 159 " . .	25·57	3·662	61·8	37·4
3. Period, " 150 " . .	114·05	14·92	275·5	152·2
4. Period, " 165 " . .	514·17	62·69	1,241·9	639·7
5. period, " 177 " . .	2,220·99	436·85	5,364·7	4,457·7
Empty cocoon	140·00	122·50	—	—
Pupa alone	1,030·00	217·41	—	—
Cocoon with pupa	1,170·00	339·91	2,826·1	3,468·5
Butterfly	503·56	142·17	1,215·0	1,450·7 (?)

The increase in the weight of the silkworms is thus quite enormous, especially after the fourth casting. When ready to spin, they have increased their live weight nearly 5,400-fold, and that too within 34 days 10 hours, the total period of development. Whereas it takes 2,415 of the newly hatched grubs to make a gramme, a single one ready to spin weighs 2·22 gr.

Before it begins to spin, the silkworm loses its appetite, crawls about restlessly, often raising its body like a sphinx, empties itself of excrements, and becomes noticeably translucent. The greatest change, however, is internal. The two spinning-glands—long, coiled conduits, lying on either side of the alimentary canal—have become gradually filled with transparent, thick, fluid silk-stuff, which comes forth from them, when the silkworm begins to spin, through the so-called spinning-teats in its head, stiffening in two separate threads. These threads, however, become instantly cemented together in a double thread in the short duct common to both, in consequence of their coating of glue. The length of this double thread varies between 350 and 650 meters in different breeds and cocoons, according to their abundance of silk.[2]

[1] After Kellner, in "Landwirthschaftl. Versuchsstationen von Nobbe." Bd. XXX., p. 75, 1884.

[2] Strong silk-threads with the appearance of violin-strings are known in commerce by the Japanese name *Tengusu;* English, silkworm-gut ; French, *fil de Florence.* In China they are made directly from the spinning-glands of full-grown silkworms, and have for some time been used with us for surgical sewing-thread, and also in large quantity for fishing-lines. (See also *Caligula japonica*, Butl.)

When it begins to spin, the silkworm chooses a corner, the fork of a twig, or some such retaining-point for its first thread. The breeder assists it in this inclination, employing various measures to promote the formation of cocoons. One of the simplest and most practical, is to spread rape-stalks over the bed of the caterpillars about to spin, the numerous light branches of which offer them facilities for fastening their first thread. In other places in Japan, small loose fagots of thickly branching brush, as long as the bed is wide, are bound up and laid across it. I observed still another method, quite different from these, at Nagahama, on the Biwa Lake. Little cornets of straw were spread over the bed, which the caterpillars easily reached and used quite readily for going into the chrysalis state.

It takes the caterpillar three or four days to change into a chrysalis. First it makes a loose, ellipsoidal case, and then, supported by this,—meanwhile twisting and bending its body, which is all the time getting shorter, it forms the cocoon. This consists of a single thread, averaging 400 to 500 meters long, and becoming thinner and weaker towards the centre (in the proportion of 3 to 4). The external, loose web, the floss-silk, German *Flockseide*, Japanese *Noshi* and *Mawata*, French *bourre*, consists of many thin, and on that account alone much less valuable, threads. A cross-section of a cocoon wall shows, when magnified, from 5 to 10 layers of silk, adhering tightly or loosely. The thread which forms them was deposited by the caterpillar in continuous backward turns one on another and sticks fast to the one adjoining. If the layers of thread lie close together, the cocoon-wall has the appearance of parchment, with a thickness of scarcely 0·3 mm. Otherwise, the structure is leafy, and rough, like felt, and the wall is 1 mm. thick. The weights in grammes of floss-silk, firm silk-web, and pupa, bear to each other the following relation, according to Haberland, taking 100 Japanese cocoons of Italian breeding:—

	Floss-silk.	Firm silk.	Pupa.	Together.
Green-spinners	0·52	16·00	108·10	124·52
White-spinners	0·48	15·34	106·20	122·02

from which it appears that green-spinners have 13·26 per cent., and white spinners 12·69 per cent. of silk in the total weight of the cocoon.

From seven to nine days after the caterpillars have spun, the cocoons are taken from their resting-places and separated from the floss-silk that surrounds them. The best are chosen for breeding, and the pupæ of the remainder are killed by being exposed to the sun, or by steam or heated air. The cocoons are then dried and put away to be wound off, or sold to large factories or reeling-establishments—filandas. A cocoon is well-shaped or normal when it has full walls and a sharply accentuated form, a fine, close web, and firmness, especially at the ends. As a rule they are ellipsoidal, though the male cocoons almost always have a saddle-shaped depression in the middle, and are smaller, but harder than the female. The so-called double-cocoons, Jap. *Tama-ito*, French *douppions*, are suited neither for reeling-off nor for breeding. They originate from two or even, possibly, three caterpillars choosing the same nook and crossing and tangling their threads when spinning. They are much larger and generally somewhat otherwise formed than the simple normal ones. But their quantity of silk is less than it would be if the caterpillars had spun themselves in separately. As a rule, none of the enclosed pupæ develops into a butterfly. They die soon after their work in common. An attentive silk-raiser will for these reasons seek to prevent the formation of double-cocoons wherever he sees they are imminent, by inserting a splinter of wood or a stiff piece of paper between the caterpillars. In Europe, special apparatus have been devised for this purpose, "Appareil cellulaire isolateur," etc., which were to be seen at the great industrial exhibitions in Paris. The pointed cocoons also (*cocons pointus*) are hard to reel-off, and so are the very large loose ones (*cocalons*). *Chaquettes* and *cocons calcinés* also are of little value, especially those in which the insect died before completing the thread. Finally there are the *cocons percés* or pierced cocoons. To this class belong first of all those from which the butterflies have escaped. They dissolve the thread at one end of the cocoon's long axis by means of a caustic liquid, and then make a hole through. But we must add to these the cocoons which are pierced by parasites—as in Japan by the larvæ of the Uchi-fly; for such cocoons likewise cannot be wound off. They can only be worked into floret-silk, like double-cocoons and the *bourre*.

Seventeen or eighteen days after the caterpillars began to spin, the butterflies (Jap. Chôchô) creep out of their cocoons, at about 8 a.m. They have broken through at one end of the long axis by means of a corrosive liquid, and now sit just outside, with their heads turned upward. The unmistakable marks of the females, are greater size, a thicker body behind, plain antennæ, and extreme inertness, while the males or cocks are characterized by the vigorous flapping of their wings. Pairing begins immediately, and is over in 6 to 8 hours, whereupon the males are thrown away, and the females set for laying their 250–400 eggs on the cards arranged for that purpose. Within 24 hours they have performed this task, and are now also cast aside as of no further use.

The round eggs or *graines*, which at first are straw-colour, become a slaty-grey within a fortnight, their fructification being indicated by the change As already mentioned, they are wrapped in paper and put into a dry, cool room, to be kept till the next breeding-time in the following spring; or they are sold to Italian and French dealers for breeding in Europe, of which details are given further on. In view of the small part played by the Bivoltini (Natsu-go, or summer children) in Japanese silk-culture,[1] a very few observations in connection with the foregoing will suffice. We learn from the well-known and already quoted work of Richthofen, that in China in olden times it was strictly forbidden to gather two silk-harvests in one year, or as we should say, rather, to cultivate Bivoltini. In other silk-raising countries this species was held in those days in the same small esteem. It would seem that their cocoons are light and the thread weak. According to Haberland, the Japanese Bivoltini (white and green-spinner) contain only 9·18 grammes, or 11 per cent. of the weight of silk of the cocoon. The worms form their cocoons thirty days after hatching; fifteen days later the butterfly appears. Their eggs are smaller than those of other species, are red in colour and oblong in shape. Ten days after they are laid, the worm is hatched, and begins a second breeding on the same plan as the first. The cocoons are usually of a long egg shape, pointed at one end.

Besides the various diseases common to silkworms, Japanese silk-culture suffers most from a parasitical insect, the larva of the Udschi fly (*Udschimya sericaria*, Rond). According to C. Sasaki,[2] this fly lays its small oval eggs about the beginning of May along the ribs of the under-side of the young mulberry leaves. The silkworm feeding on these leaves, many of the eggs are conveyed to the alimentary canal, where a thin white worm is hatched, which by means of its sharp mandibles, furnished with small bristles, bores through the walls of the canal and reaches the ganglia, where it feeds upon nerve cells. Later it enters the trachea and fleshy substance, and here it attains its maturity, coming finally forth upon the outside surface a full-grown insect. Very often it begins its course later on in the life of the worm, and continues its development in the chrysalis. The light-weight cocoon which results from its depredation is at last made quite useless by the piercing through of the full-grown fly. Killing the cocoon as soon as quite formed hinders the complete destruction of such as still conceal the living parasite within.

Greeven,[3] some ten years since, called attention to these insects and their great depredations. He states that sometimes 80 per cent. of the cocoons reserved for breeding have been found to be infested by them. Bavier also, in his book upon the silk industry of Japan, devotes some space to the subject, and notes that an average of forty per cent. of the worms in Sinshiu (Shinano), and in Musashi and Joshiu (Kotsuke) 50 per cent. are injured by these parasites.

In view of this pest, the various diseases which have up to this time interfered with the silk culture in Japan have seemed

[1] Until now the white Bivoltini have been cultivated only in the neighbourhood of Miharu, Province Iwaki.

[2] *Udschimya sericaria*, Rond. "A Fly Parasite on the Silkworm." *Nature*, Sept. 4, 1884.

[3] "Mittheilungen der Deutschen Gesellschaft Ostasiens." Heft. 7, pp. 20 and 21.

comparatively insignificant, and received but little attention. As far as has been discoverable, however, in late years, the Japan silk-raiser has to meet all the diseases common to the silkworm in European countries. His foe, Hoshii, is our Muscardine, his Fushi-kaiko appears to be what is known among us as Schlaffsucht and in his Koshari may be recognised the somewhat less frequent but equally feared Pébrine, or Corpuscula disease. As the course of this fatal Pébrine epidemic in Europe has had a most powerful reaction upon silk culture in Japan, a few more particular details may be given here. In the years 1845–6 there appeared in three of our most important industries—the culture of the potato, grape, and silkworm—diseases which were so peculiar in their character, and so widely extending, that they exercised a powerful and lasting influence upon our social life, particularly upon trade and manufactures. Chemistry speedily furnished successful remedies for the grape disease, and the potato disease after a long period disappeared as gradually as it came. But the mortality among silkworms reached at this time, viz., between 1860–1870, its highest point, and continued with greater persistence and severity. Its nature differed essentially from all the diseases hitherto known to silk culture. It was known as Pébrine, Spot or Corpuscula disease.

It appeared first in the French districts along the Mediterranean, spreading from the banks of the Herault, like the grape disease, along the waterways, over the valleys of the Clain, the Boivre, the Durance and Rhone with still greater rapidity, till in 1851 all the silk-raising Departments of France were infected. In the year 1854 it was first noticed in Italy, and its worst ravages occurred in 1856, when in many places the silk harvest fell off 25 per cent. A calamity which bore so heavily on the national welfare of France, Italy, and other countries, naturally excited the attention of governments and scientists. Numerous remedies were proposed and tried, but none succeeded. Silk-raisers betook themselves to the East, the lower Danube, to Greece and Asia Minor, in order to check the evil by the introduction of other and apparently healthier species. But it seemed as if they carried the disease eastward with them, for it spread more and more widely, till it showed itself in the Crimea, in Trans-Caucasus and Persia, and at last even in India and China. Only one country, and that Japan, remained unvisited by the pestilence, and towards Japan all eyes were turned for the longed-for deliverance. A new industry, the export of silkworm eggs, was thus developed in this country; one which soon assumed significant size, and had a powerful effect upon Japanese silk-culture at home. Before following this further, a few observations on the disease itself are in place. The existence of the Corpuscula disease shows itself at the outset in a noticeable dwarfing of the growth of some of the worms. These diminutive worms manifest little appetite, and crawl lazily and slowly about. The casting comes on later than with the healthy specimens, in the fourth making a difference of from eight to fourteen days, and the larger proportion of the worms die before reaching the spinning age. The body becomes soft, assumes a dirty yellow colour, with peculiar spots appearing first on the hairy parts. These seem at first scarcely darker than the skin, but grow gradually larger and more noticeable in shade, run together in irregular shapes, and are finally pitch-black and shining. The excretions are more liquid than in a healthy state, and covered with yellow slime, which hardens on exposure to air, flows of itself, becomes black, and often obstructs the passage. When dead the worm soons dissolves into a sickening black slime. The disease often appears first toward the end of the development of the silkworm, but carries on its work in the chrysalis, so that the ravages of the plague are plainly to be observed in the forthcoming butterfly. Much more important than these outward indications and symptoms are the workings of the disease in the body of the insect. After a most careful study of these, it has been found that the surest sign of the Pébrine is the presence of certain small egg-shaped, ellipsoidal or cylindrical bodies, 0·005–0·002 mm. in length, rounded at both ends, which look like oil drops when brought to the light. These "Corpusculs vibrants" were first investigated and described by Prof. Cornalia of Milan, and are known in consequence as the Cornalian corpuscles. The nature of these organisms, *Nosema bombycis*, Naegl., was stated much later. They are found in all parts of the diseased worm, in the excretions also, and propagate themselves from generation to generation. The healthy butterfly has none of them, but they reappear in its eggs. Upon this fact, following the teaching of the celebrated physiologist, Pasteur, has been founded the only successful remedy, or, rather, the means of controlling and removing the disease, which, consistently employed, has wrought the best results. It consists in a careful microscopic test of those butterflies reserved for breeding, and of their eggs, and the separation of every suspicious insect and particle, the special directions and prescriptions for which would take up too much time and space. It must be mentioned in this connection that the notion of Liebig and others of his time, that mulberry culture works a gradual weakening and chemical change of food through exhaustion of the soil, and thus largely causes the disease, was entirely erroneous, as I showed some eighteen years since.[1]

The summers of 1856, 1862 and 1865 were the worst seasons known to silk-culture in modern times. They were all marked in Southern Europe by sultry temperatures and long continuing rains throughout the breeding period. This abnormal and unfavourable weather, without doubt, largely increased the ravages of the disease. In Italy the cocoon harvest, which yielded in 1857 forty million kg.

[1] Rein: "Der gegenwärtige Stand des Seidenbaues." Frankfurt a/M. 1868 pp. 22–24.

in all, was reduced in 1865 to less than half this amount. The same year in France, the harvest fell from one hundred million to thirty-four million francs, and from this sum a deduction of ten million francs should be made for the cost of foreign eggs or *graines*. Where the French *graines* had cost from four to six francs the ounce, the imported article cost from fifteen to twenty. Under such circumstances the welfare of the silk districts sank rapidly. Large mulberry plantations which before yielded large income, could not find purchasers, as was stated in the French Senate in 1865, by the late celebrated chemist Dumas. Since then the conditions have improved gradually, but to the present time no European country has reached its former grade of silk production. France furnishes now perhaps one-half, and Italy two-thirds of its former yield of the raw material. The country which had the advantage over all others was as has been said before, Japan. To its export of raw silk, which greatly increased in amount and price, was now added the exportation of silkworm-eggs, and their production for foreign markets became an important element in the silk-culture of the land. Every summer a number of strangers, principally Italians, appeared to execute commissions for foreign companies, merchants mainly, who travelled by permission of the Japanese authorities into the silk districts of the interior, purchased what they required of the *graines*, and returned to Europe, where their speculating principals speedily found a market for them. These "Bivoltini," as they were humorously named, thus made for themselves a regular business, to the no small vexation of the Italian embassy and the Japanese government, both of which considered their burdensome agency as entirely superfluous, since the purchasing and exporting of eggs might have been carried on quite as well by the regular foreign merchants of Japan.

The export of silk seeds, or *graines*, in boxes, began in 1860, but must have been conducted somewhat secretly until 1865, as up to that time an old law existed, forbidding the same under penalty of death. The experiments made in Italy in 1860 and 1861 with the Japanese white and green-spinners proved very successful in those years and still later; nevertheless, a noticeable weakening of the species became evident in the second and third generation. Meanwhile the Japanese exports of *graines* increased rapidly, amounting in 1863 to 30,000 boxes, in 1864 to 300,000, and in 1865 to 2,500,000. This immense sale and enormous profit, which chiefly enriched Japanese merchants, led to cheats and counterfeits of various kinds, not only by the admixture of eggs of an inferior breed, but also of Bivoltini, so that complaints increased. On the other hand, the enlarged exportation was not without disadvantage to silk-culture at home, and the government was obliged to seek a remedy. This was found in the control and regulation of production by the government, leaving the export of silk seeds free as before. It was discovered after a while that the eggs of high altitudes hatched a better species of worm than those of the lower countries, where the breeding was more active; consequently the breeders of the province of Jôshiu, where the silk industry specially flourished, brought their eggs from Shinano. The government now permitted only those breeders living in high localities to produce eggs for seed, controlled the breeding, and stamped the boxes with the official seal before they were forwarded to treaty-ports. This regulation had little effect for good upon either the home industry or the export, which underwent many vicissitudes of quantity and price, and which in modern times has greatly decreased. The price reached the highest limit in 1873, when the average worth of a box was 2·15 yen, or about eight shillings and sixpence, while in 1877 it had fallen to 0·29 yen, or one shilling and twopence the box. In 1868 there were exported 1,886,325 boxes, worth 3,782,351 yen, or about £727,912; in 1877, 1,167,502 boxes, worth 341,467 yen, or a little more than £66,954.

The silk-culture of Japan is, as has been before remarked, limited to the principal island of Hondo. Of the various silk products of this island (Japanese Kinu or Ito in the most general significance) which are sent to Europe and the United States from Yokohama, the most important is reel-silk (Japanese, Sage Ito; French, *grège;* English, hanks), which is only excelled in quality by the French and Italian. Besides this, there is the silk waste of all kinds (French, *déchets*), which serves for spun silk or flurt, and which includes especially the refuse that occurs in the course of cultivation. This consists of flock silk (French, *blaze*), or the loose web of the silkworm, inside of which it forms its cocoon, the *Tama-mayu*, or double cocoons (French, *douppions*), the Degara (French, *cocons percés*), *i.e.* cocoons from which the butterflies have crawled out, and also imperfect cocoons. The Japanese uses all those varieties of cocoons which are unsuitable for the manufacture of *grège* for his Ma-wata, or silk fleece, after they have been softened in a weak lye of wood or straw ashes, then cut up and the dead chrysalis thrown away. The silk is then picked off from the cocoon with the fingers, and fastened to the ends of small sticks in order to keep it straight, the fleece from twenty to sixty cocoons lying piled in this way together. When dry, this is used as lining for clothes and bed quilts, or is spun as wool is with us, or is shipped and sold with other silk waste. Another kind of refuse comes from the unwinding of the cocoons. This takes in especially the outermost web of the cocoon, which, after soaking in warm water, is beaten by a small hand-broom. Some silk necessarily clings to the broom before the proper thread is found, and these ragged bits are called in Japanese, Kawa-muki (bark silk), Noshi-ito, and Shike-ito, in French, *frisons*. To these are added the threads broken in reeling, as well as the imperfect cocoons.

The silkworm eggs (Jap., Tane; French, *graines*), form another article of export, the importance of which has been already noted;

and lastly we have the woven fabrics brought to the foreign markets.

The three geographical silk zones of Hondo are distinguished by the dealers in Yokohama according to the quality of the reel or raw silks and their "make-up," *i.e.* the manner in which the skeins are laid together in packing.

a. The northern district yields the Ôshiu silk, so called from the province Ôshiu, which furnishes about 20 per cent. of the entire production, and exports 25 per cent. of the seed or *graines.* The city of Fukushima, on the Abukuma-gawa, is the centre of the most active silk culture in Ôshiu. The district embraces that section of country lying between 37° and 38⅓° N. lat. and 140° and 141° E. long. To it belongs—

(*α*) The province Iwashiro, watered chiefly by the Abukuma-gawa, with its cities Fukushima, Yanagawa, Nihonmatsu, Motomiya, Moriyama, and Sukagawa, as well as other well-known silk-raising localities.

(*β*) The province Uzen, north-west from Iwashiro, and north of the Aidzu-taira, with the cities of Yamagata, Kaminoyama, and Yonezawa. The neighbourhood of this last named city, with the localities Koide and Narita, furnishes a large quantity of specially prized Tane to commerce.

(*γ*) Iwaki, whose largest silk market is the city of Miharu. The more northerly provinces, from Sendai to Echigo, lying in the western part along the Japan Sea, are far behind these three in the worth and quantity of their Ôshiu silk.

b. The central district joins the foregoing on the north, stretching toward the south-west from about 37° to 35½° N. lat., and between 137° and 139½° E. long., westerly and north-westerly from Tôkio. This district embraces the provinces of Kôdzuke (Jôshiu), Shinano (Sinshiu), and Kai (Kôshiu), besides joining Sinshiu, the provinces of Hida, Kaga and Echiu, in which silk-culture falls far behind the first-named three; and finally east of Kôshiu and Jôshiu the western and hilly Musashi, as well as Shimodzuke and Hitachi, which furnish only a small amount of silk.

This central zone of Japanese silk-culture takes prominent place inasmuch as it produces 65 per cent. of all the Japanese silk in the market, and 70 per cent. of the seeds or *graines.* From Jôshiu comes 30 per cent. of silk and 15 per cent. of the *graines.* From Sinshiu, 27 per cent. silk and 60 per cent. *graines,* and from Musashi about 15 per cent. of silk only. It appears, therefore, that Jôshiu is the most productive of all the silk fields of Japan. The country surrounding, Mayebashi, Takasaki, and Numata, is specially noted for silk production; and Mayebashi hanks, or Mayebashi *grappes,* lead the price all the Japanese reel silk. In the high-lying province of Shinano also, there is great activity in silk-culture, which excels all other occupations as a source of livelihood and gain. Its production also is highly prized in the market, and is confined largely to the environs of Uyeda on the Chikuma-gawa, of Nagato and Ida.

c. The southern silk district joins the central towards the south-west, and comprises the provinces Mino, Omi, Echizen, as well as Tamba, Tango, Tajima. Besides these, the remainder of south-western Hondo has little to boast in the way of silk-culture. This is also true of the provinces of Tôkaidô, with the exception of Kôshiu and Musashi, already mentioned, and in Gokinai, Sanyodo and San-in-do in the west. It is furthest developed in Mino, principally about Hachiman, and in Gôshiu or Ômi, east of the Biwa Lake, where Nagahama is especially distinguished for the amount of territory devoted to the industry. This third silk zone supplies to the remainder of the Japanese silk product 15 per cent. of raw silk, and 5 per cent. of seed cartons, and falls far behind the middle and northern sections in importance.

The export of Japanese raw silk began in 1859. The high price received in consequence of the diseases prevalent among the silk-worms in Europe proved a great stimulus to wider culture and production. The falling off in consequence of the growing trade in *graines* was found to be but temporary. A noticeable improvement in the exported *grège* took place, as in 1872 the government built at Tomioka, in Musashi, a great reeling establishment, or *Filanda*, in which the cocoons were unwound in a fine even thread under Brunat's skilful direction. The high price of this raw silk from Tomioka has caused a great deal of emulation, and a large number of Filandas have sprung up in silk-raising centres and silk-markets, generally at the suggestion and expense of the government. In this way the quantity, relative value, and total amount of the exported silk products of Japan have greatly increased, notwithstanding many disturbances and fluctuations. In 1883 it reached the highest figures yet known, viz., 56,432 Piculs at 60,128 kg.; but the value fell some 350,000 yen behind that of the previous year, when for 52,021 Piculs the sum of 18,638,984 yen (nearly £3,654,703) was realized.

The Breeding and Importance of the Yama-Mayu, or Oak spinner—Antheria (Bombyx) Yama-maï Guér.-Ménev. in Japan.

The effort to find some substitute for European silkworms decimated by the Pébrine (*Nosema bombycis*, Naeg.) has led not only to the introduction of Japanese white and green spinners, but has attracted attention to other Bombycides, and caused numerous experiments. The most encouraging attempts at new breeds have been made with Japanese and Chinese Oak spinners (*Antheria Yama-maï* and *Anth. Pernyi*), the former from Japan, and the latter from the Chinese provinces Shantung and Sze Chuen, chiefly; also with the Ailanthus spinner (*Saturina Cynthia*) which is much cultivated in Shantung, and which furnishes the so-called Pongee silk of China; with the East Indian Ricinus spinner (*Saturnia Arindia*) and the Indian Oak spinner (*Saturnia Mylitta*) from which is made the Tussah silk of Assam and Bengal. But the results have not justified the hopes built upon the efforts. The evidence has been convincing that no other can take the place of the Mulberry spinner, and that in future it will be the most important silk producer.

The attempts made with the Japanese Oak spinner (*Antheria Yama-maï*, G. M.) aroused the liveliest interest of all. In its various developments of egg, worm, chrysalis and butterfly, it furnished very much that was instructive, besides surprising size and beauty. The strong, shiny silk thread of its yellowish green cocoons reels off like that of the Mulberry spinners, and furnishes a durable web. As the Oak spinner feeds on the green summer foliage of the oak, and also likes the leaves of our common oak-trees, and was reported as being much cultivated in Japan and its silk highly prized there, the great expectations aroused by the experiments are easy to understand.

Several governments interested themselves in the attempt and encouraged it, as Switzerland, which in 1865 ordered through her consul in Yokohama, 6 kg. of eggs, and three years later a larger amount. Samples were sent me from both packages, for testing, and I made breeding experiments with both, as well as with the eggs which Herr Baumann, Postmaster of Bamberg, had obtained. The reports published regarding the results of the experiments on the part of others were very unfavourable and agreed entirely with my own experiences. The great activity of the young worms, their lack of quiet association with each other at all ages, great mortality even after the fourth casting, and the length of time necessary for their development, were the principal objections which the investigation brought to light.

At the time of the Paris Exhibition of 1867, it was evident that the hopes built upon Yama-maï were vain. In the Jardin de l'Acclimatation, where in 1861 the first worms of this species were cultivated, and their peculiarities studied by Guérin-Méneville, the effort was abandoned. The favourable results obtained by Camille Personnat in Laval, and his endeavours during the Exhibition to awaken interest for the new breed, had no more effect to stimulate the waning hope than had other single and individual efforts in Germany and Austria. During my stay in Japan I tried to become accurately acquainted with the preparation and uses of Yama-maï silk. I was moderately successful on the remote mountain slopes where the cultivation is most thorough, and among the weavers and dyers in several cities in the interior of Hondo where this silk is manufactured, and where I could, by personal observation, arrive at some certain opinion on the subject. In this way, I came to the conviction that the importance of Yama-maï silk has been greatly over-estimated, both in Japanese writings, some of which have reached us in translations, and in the Consul's reports, which have been made from oral testimony of not very reliable character. Von Scherzer,[1] too, must have been falsely informed when he wrote, "In Japan itself, this product, mixed sometimes with cotton and at others with common silk, is much used in the manufacture of clothing material."

The Japanese designation Yama-maï, better Yama-mayu, signifies mountain (yama) or wild cocoon (mayu); the worm is called correspondingly Yama-ko. According to old statements, at the time of the conquest of Hachijô-shima (pronounced Hatchijo-shima)[2] by the Japanese in 1487, this species of silkworm became widely diffused over the island, and its silk product greatly prized. Its introduction into the chief island, where it was probably never native, and certainly is nowhere found wild, took place considerably later.[3]

The localities which seem most favourable to the Oak spinners in Japan lie, as a rule, in the usual silk districts and generally on the mountain slopes. This is specially true in the province of Shinano, which furnishes the largest quantity of Yama-maï silk. I know of four districts in this province where the Oak spinner is bred more extensively than elsewhere, viz.: the country about Uyeda on the Chikuma-gawa, Iida on the Tenriu-gawa, Ikada, and Matsumoto in the valley of the Sai-gawa.

The Matsumoto district spreads ten or fifteen miles westward to the spurs of the Shinano-Hida Snowy Mountains and some thirty miles in the same direction from Yokohama. The Matsumoto-Gumi is a company (Gumi) which works in fifteen communities of the district, and has for its object the production and manufacture of the Yama-maï silk. There are, however, small establishments in and near Matsumoto itself.

The worms are chiefly raised in the open air, the leaves of *Quercus serrata*, Thunb. (Jap. Kunu-gi or Kunugi-nara)[4] serving as food. This tree grows to a considerable height, even in dense groves, and is common in the north of Hondo. Its leaves remind one of those of the edible chestnut, and like them, appear late in spring. The young seedlings after one year's growth are planted in rows in a sheltered place, and after three or four years and frequent cutting back, grow to bushes two meters high, with plenty of room between them for passage and free circulation of air. When the plantation

[1] K. von Scherzer: "Die Oesterreichisch-Ungarische Expedition nach Ostasien." Stuttgart, 1872.

[2] Hachijô-shima lies south of Shichi-tô, 33° 8′ N. Lat. and 139° 50′ E. Long. On the map it is often put down under the old orthography Fatsicio and Fatsi-syo.

[3] I saw in the British Museum *Antheria Hazina*, Butl., and *Antheria Morosa*, Butl., from Japan, which I took for varieties of this species.

[4] The leaves of *Quercus dentata*, *Qu. acuta* and *Qu. glauca* are also sometimes used.

is thus prepared, the eggs are deposited on the branches about the beginning of May, when the young leaves are making their appearance. About 20 to 30 eggs are pasted on strips of paper which are bound to the branches, so that the young worms when hatched may find food and protection from the sun. Against rain they protect themselves by creeping with wonderful quickness to the under-side of the leaves, whereas the old and heavy worms often suffer in violent storms. Their numerous enemies in the open air are, besides insects (particularly ants), tree toads, rats and birds, chiefly ravens. These are kept off, partly by painting the lower parts of the trunk with a sticky substance, such as the root-slime of Hibiscus Manihot—partly by scarecrows and rattles which hang on a rope extending across the whole plantation, and are kept in motion by a person who sits on a high roofed seat in the middle, and watches over all.

The development of the worm up to time of spinning takes about sixty-four days. It is divided into five periods, the first two of ten days each, the third and fourth of thirteen days, and the fifth and last eighteen days. This time however is subject to modifications of many kinds. With a high even temperature and rich food, it can be reduced to fifty days, and contrariwise lengthened to eighty. Each casting is preceded by a two or three days' sleep, during which the worm sits motionless, holding fast by its hind feet and raising its fore parts after the manner of the sphinx.

The young worms, at hatching 7 mm. long, with reddish brown feet, but otherwise yellowish green in colour with two long black stripes, after the fourth casting have a length of 7 cm., and are 2 cm. in circumference. They are then of a fine green colour, well ringed, and on the back have two rows of warts, each of which is furnished with blackish brown hairs. Gold-yellow stripes on each side, on each of which are five silvery spots, breathing places, separate the back from the belly.

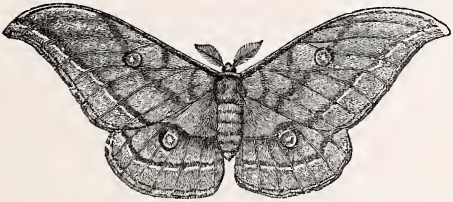
When the worm is ready to spin, a light brown liquid exudes, and it becomes restless, does not raise itself up however, but draws one or more oak leaves about it, spins them together over its head, and fastens its cocoon to them. In making the cocoon, it first weaves about itself a transparent net of fine yellow-green silk, through which it can be seen industriously spinning. After about six hours the net is no longer transparent, and after six or eight days the cocoon is completed. Meanwhile the green of the inner web has lost its intensity and become only a greenish yellow on the outside. The cocoons are firm and of a beautiful ellipsoidal form, without shrinkage in the middle, and about three cm. long, and of 7 grammes weight. Without the chrysalis its weight is from 70 to 80 cg., while an empty cocoon of the Bombyx Mori is not half so heavy. Ten pounds of cocoons yield about 1 kg. of reeled silk. The top layer has a coarse thread of greenish yellow, but the underneath has a fine greenish white silk which, after soaking in

SILKWORMS ON QUERCUS SERRATA.

[*Page* 246.

hot water, is reeled off almost as easily as from the B. Mori. About fifteen days after the metamorphosis has taken place, the cocoons are taken from the leaves and tested. Those which are to be reeled, are placed in the warm sun or the regulated heat of an oven, to kill the chrysalis. The best are set aside for breeding, and after from 20 to 25 days the butterflies come forth. In order to prevent them from flying away before propagation, they are kept in pairs in bell-shaped baskets, woven from bamboo and suspended

FEMALE OF THE ANTHEREA YAMA-MAÏ GUÉRIN-MÉNEVILLE, HALF THE NATURAL SIZE.



MALE OF THE ANTHEREA YAMA-MAÏ GUÉRIN-MÉNEVILLE, HALF THE NATURAL SIZE.

on poles. After the female has laid her eggs on the inner wall of the basket, they are carefully collected in bags and placed in a dry, cool and airy place till the time for the new breeding.

The eggs of the Yama-maï are nine times as heavy as those of the Bombyx Mori, although it takes from 130 to 140 of them to a gramme. They are spheroidal, *i.e.* depressed at the ends after the manner of a Mandarin orange. Their dark brown colour, with black spots and stripes, is due to a sticky coating, which disappears when they are washed in water or a solution of soda, showing the egg white, as with some is really the case from the first. On breaking the egg one is surprised to find no yolk, but instead a well developed little worm lying curled up till awakened by a certain degree of warmth. Then they break the parchment-like shell at the point where the head lies, generally during the morning hours, and creep out, already so rapidly grown that they measure some seven or eight millimeters, or about four times as long as the diameter of the egg.

Yama-maï silk is more expensive than other varieties. In 1875 at Matsumoto 25 momme (c. 93·75 grammes) of reel silk of this kind cost one yen, while for the same price could be purchased 35 momme of ordinary silk. The relative price of the two is about as 7 : 5, which is due as much to the difficulty of raising the Oak spinners as to the quality of the product. From these statements a Picul of Yama-maï silk may be reckoned as costing 640 dollars; this agrees with the testimony of Bavier,[1] according to whom a Picul varies in price according to quality, from four to eight hundred dollars, or from 27 to 54 shillings the kilogramme. He also states that the total Japanese production of Yama-maï silk amounts to about 100 bales, each 75 lbs. English in weight, and amounting to about 3,400 kg. It was not possible for me to prove the correctness of this statement for which Bavier does not make himself responsible; but it seemed to me that the estimate was over rather than under the real yield of the harvest, since the Yama-maï silk is kept in the home market and can only be used there in a limited quantity. (See Art Industry: Textile Industry.)

The Chestnut spinner (*Caligula japonica*, Butl.) is the only one of the wild Bombycides in Japan whose cocoons or worms are sometimes gathered and used. It is called Sukari, the worms Genziki-mushi (camphor-spinners) and also Shiraga-mushi (grey-haired worms).[2] Hilgendorf in an article entitled, "The Camphor Spinner (Genziki-mushi),"[3] first called attention to this insect and its most important features, which he had learned mainly from Japanese sources.

This species of worm feeds upon the leaves of the chestnut, walnut, different varieties of oak and sumach trees, and in Southern Japan upon the camphor-laurel also. I found it often in my travels in Japan, and became convinced that its favourite food is the Kuri (*Castanea vulgaris*, Lamk.). The large worms feed upon chestnut trees standing alone, till they are often quite bare, and strip even whole groves of these trees, while they generally avoid other kinds of trees standing near. Moreover, as the worm and the tree seem scattered together alike over the whole country, I prefer to call it the Chestnut spinner, as that is the only really fitting designation. The belly of this great worm is light green, the back

[1] "Japan's Seidensucht," by E. von Bavier, p. 99.
[2] "Official Catalogue, Japan section." Philadelphia, 1876, p. 120.
[3] "Mitth. d. deutscher Ges." etc. 9 Heft. Yokahama, 1876.

a greyish white. A row of beautiful blue spots on each side marks its breathing places or tracheæ. Silky grey-white hairs a centimeter long cover its surface, and in connection with the light colour of the insect itself, make it resemble the catkins of the tree which furnishes its food.

The Chestnut spinner does not weave a perfectly closed cocoon, but a rather coarse net-like web of brown colour, whose thread is hard to unwind and can only be used as woof in coarse fabrics. It seems that in earlier times the worms, when ready to spin, were used more often than nowadays for the so-called Tengusu (Silkworm guts); it was laid in vinegar, the spinning-glands opened carefully, and the silk drawn out in threads several feet long. But now as a finer and much cheaper material for this purpose comes from China, even Japanese anglers give it the preference. (See note, p. 196).

5. Forestry.

Relation of Japanese Forests (Hayashi) to Cultivation in general and to Waste Land.—Distinction between Cultivated and Natural or Mountain Forests.—Character, Extent and Value of both.—Influence upon Climate.

According to a previous summary of the land economy and classification of Old Japan (pp. 11 and 12), which was founded upon official statistics of the year 1879, of the entire area, amounting to 28,356,945 chô, 17,356,945 chô consisted of mountain forests and desert land without cultivation, and 5,240,570 chô of cultivated forests. Recently, however, the section now under consideration, between Tsugaru and Colnet Straits, has been reckoned as much larger, viz., at 28,842,011 chô, as is given in the report of the Japanese section of the Forestry Exhibition in Edinburgh, 1884. The entire amount of woodland is estimated in this publication at 11,866,625 chô, of which 5,259,182 chô is government, and 6,607,443 chô private, property.

The distribution of both classes of forest in the three principal islands and their smaller dependencies is shown in the following table:

	Whole.			
	Area.	Forest.	Government Woodland.	Private Woodland.
Honshiu . . .	22,846,603	9,993,021	4,226,803	5,466,218
Shikoku	1,837,344	1,175,700	358,381	817,319
Kiushiu	4,158,464	696,922	374,017	322,905
Old Japan . . .	28,842,411	11,865,643	5,259,201	6,606,442

It follows from this that the forests of Japan Proper form 41 per cent. of its entire area ; in Honshiu, 44 per cent. ; in Shikoku, 64 per cent. ; and in Kiushiu, 17 per cent. The relative proportion is still further reckoned, in the work cited, per capita, *e.g.* to every inhabitant of Japan, 3·25 tan of woodland ; in Honshiu, 3·529 tan to each person ; in Shikoku, 4·4 tan ; and in Kiushiu, 1·32 tan. As a tan may be estimated at about 10 Ares, the proportions may be carried out at 32·5, 35·25, 44, and 13·2 Ares respectively. In Honshiu, the principal island, the south-western portion, or Chiugoku (Sanyodô and Sanindô), is the least wooded. There are no high mountains in this part of the island, and mining has in many places, especially in the country surrounding Ikuno in Mimasaka, wrought such desolation of the timber lands as to cause a dearth of wood.

The following more exact classification of the acreage of Japan is made up from facts given in the before-mentioned report, pp. 11, 12.

	Chô.		Per cent of total area.
(*a*) Desert land	10,730,890	or	37
(*b*) Mountain forests	6,626,050	„	23
(*c*) Cultivated forests	5,240,570	„	18
(*d*) Farming land (Ta and Hata) . .	4,280,000	„	15
(*e*) Other Cultivation, including improved Hara, about	1,364,900	„	5
(*f*) Building ground and roads . .	600,000	„	2
In all . . .	28,842,410		100

Of these figures only those under (*e*) and (*f*) rest upon taxation and are uncertain, but these, as well as those under (*d*), regarding agricultural lands, do not concern the present topic.

The desert lands consist for the most part of the almost worthless Hara, grassy surfaces which spread around the base of high volcanoes, and, as a rule, surround the mountain timber lands. I have treated of the particular character of these forms of vegetation in vol. i. of this work. It is almost beyond doubt that the Hara would be for the most part gradually transformed into forest, if it were not for the devastating autumn fires, which not only eat up dried and dead vegetation, but the self-sown seedlings of wood-growth as well. It is only in ravines and other protected places where it is possible for such plantations to grow and flourish.

A larger portion of desert land consists of bare ridges of hill country and mountain sides which often alternate with the wooded slopes, and justify the opinion that they, too, were once covered with forests. After they were denuded of these,—whether to satisfy the demands of mining carried on in the neighbourhood, or to allow the brake-fern to spring up better after a bush fire, or for whatever purpose it may have been,—the heavy rains had free course, robbed them of their compost matter, and made it difficult for natural or cultivated forests to re-appear upon these slopes.

A third portion of the woodless and cultureless surface is to be found on the peaks of the higher mountains beyond the forest limits, where either the violence of the wind and roughness of climate in general, or a lack of proper qualities in the soil, account for the barrenness. It is well known that volcanic eruptions, even if they are but the after-fumes of violent outbreaks in the form of Solfatara, destroy vegetation in a wide extent of country. The Solfataras operate in the same manner here as sulphuric acid in the reduction of sulphuretted ores. And, finally, we must reckon with the desert country the sand-hills of the coast, which may yet become partly amenable to arboriculture, but of which survey has yet to be made.

The desert and forest lands of Japan Proper together make up nearly four-fifths of its entire surface, as will be readily seen from the figures given above. Of this, more than half is forest land. It forms consequently the most extensive and marked feature of vegetation in the landscape. Its percentage (41) of the whole area is larger than in those European countries which are richest in timber land. It is also a highly important factor in the natural economy of Japan, even though but a small portion has as yet been properly subjected to cultivation.

The attentive traveller easily recognises the great difference in the forests of Japan, according as they belong to the hardly accessible mountains or to their slopes, to the hilly, or the level country. In fact, it is according to the use which can be made of them that they are distinguished as cultivated and natural, or mountain forests; and this also is largely dependent on their situation. The lack of good roads and other conditions of traffic have allowed the latter to preserve more or less of their original character, because of the difficulty of access. The need of wood, especially such as is available for building purposes, and such as the Coniferæ best furnish, gave rise to the cultivated forests. These accordingly appear as dense and more or less monotonous pinewoods, while the mountain forests, as already remarked in the first volume of this work,[1] are notable for the multiplicity of species mixed together. The largest part of the cultivated forest land is private property, while the mountain forests belong to the State.

The cultivated woodland serves principally, as already indicated, to supply the necessary building material. For ages, dwelling houses have been made of wood, light and airy structures lacking solidity, for the Japanese carpenters have no idea of the use of retaining arches in any kind of framework, nor the necessity of

[1] Under "Forests (Hayashi)."

support on any solid foundation. In this way the Japanese house affords, even during the hot summer months, a cool dwelling. In winter, however, when the rough winds blow, their cold blast rushes in at every joint. Warm clothing then furnishes the only protection against cold, as the heating arrangements are by no means adequate. The houses are roofed with straw in the country, and in cities with shingles or tiles. The shingled roofs have bands of bamboo-cane crossing each other at right angles and fastened with wires, so as to hold the shingles in their places in case of violent winds. In high localities the roofs are still further protected by stones, as is done in European mountainous countries.

The light wood framework, the lack of chimneys and proper heating apparatus generally, as well as the custom of building the houses close together in cities and large towns, greatly increase the danger from fires. Fearful conflagrations are frequent, particularly in Tôkio, with its great sea of houses. These materially increase the need of arboriculture, and form the chief reason why for years a systematic laying out of forests has been carried on. For while the great superfluity of wood in the mountains has been unavoidable, because of the lack of proper roads and conveyance, and much timber must inevitably go to waste, the lack of wood in settled localities for centuries could only be met by forest cultivation. Under such conditions it is quite probable that the Japanese tradition concerning the planting of forests 1,200 years ago in Dai-Nippon is well founded. This could not have been a systematic, well-aimed and State effort however, as its sole purpose was, as has been said, simply to supply the need for wood. It is only in later years that the Japanese have learned that the utterly neglected mountain forest is a main source of prosperity for the country, and that not only in its wood supply, but in its climatic influences. From this time we see the energy with which scientific forestry has been developed, as appeared in the Japanese section of the Edinburgh Exhibition in 1884.

The best building timber, at the same time hard, tough, and durable, is the Keyaki (*Zelkowa Keaki*, Sieb.), but in consequence of the high price, it is used mostly for joiner-work. For the same reason the greatly prized pinewoods also, like Hinoki (*Chamæcyparis obtusa*, Endl.), and its kindred, Tsuga (*Abies Tsuga*, S. and Z.), Kara-matsu (*Larix leptolepis*, Gord.), Ichii (*Taxus cuspidata*, S. and Z.), are not used in house building, as their excellence would warrant, but serve the purposes of decoration in the more expensive dwellings. The usual building-wood for houses is furnished by the quick-growing Sugi (*Cryptomeria japonica*, Don.), also the Momi (*Abies firma*, S. and Z.), and a still cheaper and much prized wood having many varieties, the Matsu (*Pinus densiflora*, S. and Z., and *P. Massonia*, Lamb.), used also largely in bridge building, for which the more brittle Sugi wood is less adapted.

It will be seen from the foregoing why so much attention is given to the culture of Sugi and Matsu. It is highly probable that all these pine forests and also those of the cypress family (*Chamæcyparis* and *Thujopsis*) are of artificial cultivation, since experience has shown that their self-propagation, like most Coniferæ, is difficult, and wherever a pine forest disappears, its place is usually filled by blackberry bushes, wild roses, and other almost worthless deciduous growths.

For fuel, in the dwelling houses, the charcoal of the various Cupulifera is used universally, especially that of the chestnut or Kuri (*Castanea vulgaris*, Lamk.) and of several deciduous oaks, such as Kashiwa, Kunugi, and Nara (*Quercus dentata*, *Q. serrata*, and *Q. crispula*). As this wood is used for several other purposes also, it is very much cultivated, and found in plantations devoted entirely to it, although they are not to be confounded with the mountain forests.

The same is true of the evergreen Shii-no-ki (*Quercus cuspidata*) which is confined to the warm south, and is also cultivated on account of its valuable wood.

All the above-mentioned forest trees, and some others less wide-spread—the Kôya-maki or screen fir (*Sciadopitys verticillata*) among them—are raised from the seed in nurseries, as with us, and the seedlings transplanted after two years' growth. The cultivation of the plants during these two years, as well as the laying out of the plantation, is very carefully managed and based on all the teachings of past experience. There is also no lack of printed instructions with all necessary illustrations.

The ground chosen for such a plantation is prepared as thoroughly as for a fruit-tree nursery or a tea-garden, and is well enclosed with a light and pretty bamboo hedge, from one to two meters high, which does not hinder light and air. In snowy districts a further protection is provided in winter in the shape of a straw roof, known as the Yuki-ôi ; and in case it becomes necessary to shelter the young plants from the cold, as *e.g.*, with the Ko-kuri or young chestnut, straw fastened to a bamboo framework is spread over them.

The greatest care is also observed in taking up the Naye or young seedlings, cutting back their perpendicular roots, making ready the plant holes with the hoe, and planting again in the ground laid out for the new forest. I did not find, however, that our system of planting in rows was very much adhered to ; much more regard was had to the nature of the ground, and to the peculiar taste which has a dislike for systematic regularity on a wide scale, except where it may be necessary, as in agriculture.

The cultivated forests of Japan are seldom very large. Poor gravelly soil, fixed dunes and other sandy districts are, as a rule, devoted to the above mentioned pine trees, just as in the Département des Landes, the Pinus Pinaster Solander (the pine of the country) is cultivated. The other species of cultivated conifers need a deeper and better soil, which is to be found only in the plains.

They are sometimes found however, as the Chamæcyparis and Thujopsis, on the lower gentle slopes of mountains. In case the soil here is too stony and unfruitful, the chestnut is planted, while the oak is better adapted to the saddles and hollows. It is seldom however that forest cultivation of any kind goes higher than 1000 meters. In Yezo, according to Böhmer,[1] the only forest tree that is cultivated by Japanese immigrants, on account of its wood, is the Cryptomeria.

In comparison with the numerous forests and groves of Sugi and of pines (*Pinus densiflora*, or Aka-matsu, and *P. Massoniana*, or Kuromatsu) distributed over all the provinces, the solitary groves of other cultivated coniferous trees sink into insignificance. Those of the Cypress family, viz., Hinoki, Sawara and Hiba (*Chamæcyparis obtusa*, *Ch. pisifera*, and *Thujopsis dolabrata*), are found more extensive and in a finer development in the middle portion of Hondo on the peninsula of Yamato and in the district of the upper Kiso-gawa. Previous to the restoration of Mikado-rule they belonged mostly to the two powerful Daimios of Kishiu (Kii) and Bishiu (Owari). Iyeyasu, by a special law, had made it the duty of the rulers of these provinces to provide the necessary Hi-no-ki wood for the building and renewing, every twenty-one years, of the national sanctuary in Ise (temple of the Sun-goddess Amaterasu), and to give their constant attention to the forests of this tree, releasing them at the same time from all other general tribute. In explanation of this it ought to be said that Hi-no-ki and Sakaki (*Cleyera japonica*) were and still are the holy plants of the sun-goddess, and also of the Shinto or ancestry-worship. And all temples so dedicated, as well as the former residence of the Mikado in Kiôto, were built of the wood of the Hi-no-ki.[2]

Of all the pine-woods of Japan which form a part of its arboriculture the beautiful screen fir (*Sciadopitys verticillata*, S. and Z.) is certainly the least propagated. It is found in large plantations only on the mountain slopes around Kôya-san in Kishiu (hence called Kôya-maki). Dr. Yaroku Nakamuro gives also *Podocarpus Nageia*, and *P. macrophylla*, as components of the cultivated pine forests,[3] but I always met them only as ornamental trees, like the Ginko.

The bamboo groves (Yabu, Take-yabu) may also be ranked as cultivated forests. They serve the most manifold purposes, making an agreeable diversion in the landscape, and are especially frequent

[1] "Reports to the Kaitakushi." Tôkio, 1878.

[2] See also Rein, "Japan," vol. i.

[3] "Ueber den anatomischen Bau des Holzes der wichtigsten japanischen Coniferæ, Untersuchungen aus dem forstbotanischen Institute in München," iii. 1883.

on the boundaries of the larger cities, where great use is made of the cane.

The contrast between our glades with their many varieties of flowers, and the well kept but monotonous sward of our gardens and public grounds, is much the same as that between the Japanese natural mountain forest,[1] with its variegated growths of many kinds, and the regularly formed pine or deciduous forests, which it has been found necessary to cultivate. Here in the mountain forest as in the Hara, nature, so rich in Japan in variety and shape, has preserved its original physiognomy. But richness of variety does not by any means betoken an abundance of valuable timber in such a forest any more than of fodder in the wild meadow-land, and an Eldorado to the lovers of nature and of plants is not always such when viewed from the point of national economy.

In the wild and neglected forest—whether primeval or run wild is of no importance—life and death, sprouting and withering vegetation are mixed together in a wonderful way. H. Cotta [2] says in reference to this, that forests grow and flourish best in places where men do not live, and consequently where no forestry is carried on. It is a wide-spread but none the less erroneous view that the primeval forest is particularly rich in wood. It includes giant trees interspersed with every grade of the most diverse wood-growths, down to the lowest bush, but produces by no means the total amount of timber yielded by a highly cultivated forest covering the same surface, where valueless kinds of wood are kept back in order to better provide the light and air necessary to a finely developed growth. And so the forester reduces the number of species in a natural forest by the axe and other means, just as the continued manuring and cultivation of a meadow works an impoverishment of its Flora. With the numerous motley grasses and weeds the equipoise is disturbed, and an unequal development caused in which the weakest surrenders.

As is more carefully noted in vol. i. p. 146, Asa-ki, the deciduous forest of Japan, in contrast to Kuro-ki, or the dark pine forests, and to our own woods with their few species, is made up of a great mixture of large numbers of trees and bushes in all stages of growth. It is exceptional and generally due to special cultivation when we find chestnuts and the varieties of oak forming separate plantations. Creepers and climbing plants, parasitic and rooted ferns are seen in greater variety and larger growth than with us. "To name all the constituents and inhabitants of a Japanese forest of deciduous growth would be to catalogue not less than half the Flora of the country. In the higher mountains and more to the north are only a few evergreen bushes, and no trees, conifers of course excepted. The most common constituents of these forests are oaks, beeches, hornbeams, maples, birch, horse chestnuts, magnolias, aralias, wal-

[1] Yama, or mountain, is the commonest term for a natural forest.

[2] Preface to his "Anweisung zum Waldbau."

nuts, elms, planes, various rosaceæ and in moister places, ashes and alders also" (vol. i. p. 147). As the most important of these will be discussed in the next chapter, which deals with their timber, I need not here enumerate their botanical names.

Among the larger and most important of the deciduous trees of the island of Yezo, may be mentioned the magnificent magnolias (*Magnolia hypoleuca* and *Cercidiphyllum japonicum*), chestnuts, horse chestnuts, walnuts, maples, alders, birch, ash, elm, linden and the deciduous oaks.

The Japanese Asa-ki is not at all a primeval forest. It may here and there even be a plantation on what was once a field,[1] but it has the stamp of a thoroughly natural growth, and is left to itself and renews itself. The woodman visits it with his axe, it is true, but only for the sake of the most valuable and scattered timber, such as Hô-no-ki, Saru-suberi, Tsuta-no-ki, (*Magnolia hypoleuca*, *Stuartia monadelpha*, *Actinidia volubilis*), and some others, but this does not in any wise affect the settled character of the forest. This is accomplished by means of thorough destruction by forest fires. As the Capoeira, in the forsaken plantations of Brazil, consist of plant-forms entirely different from the primeval growth, so is it here also. Its place is taken by a brushwood in which the narrow-leaved wild rose (*Epilobrium angustifolium*, L.) springs up here and there as in our burnt forest grounds, the stiff bamboo grass (*Phyllostachys bambusoides*, S. and Z.), and in high damp places also the Itadzuri (*Polygonum cuspidatum*), nearly three meters high. The forest generally takes on its original character by degrees and after a long time.

In the deciduous forests of the mountains, the beech is among the most frequent of trees. It shows itself here, as with us, a tree which nourishes the ground in a high degree, as one may see from the luxuriant foliage[2] and the brush of the Lomaria and other ferns which grow nearly to a height of one meter in the rich soil. It also forces the various other trees which are associated with it,—among them magnificent specimens of Magnolia hypoleuca, Calopanax ricinifolia and Æsculos turbinata, notable for their large, strange leaves,—to produce long boles without many branches. This is also done by the Momitanne (*Abies firma*) which grows in wide-spread localities.

It is clear that the composition of the natural deciduous forests of Japan varies with the elevation as well as with the latitude. Besides a large number of trees and bushes which are always

[1] According to a written communication kindly sent me, the famous academician Maximovicz, in the year 1863, botanized for a time near Nagasaki in a forest so high that he took it for a primeval one, till he recognised in the terracing of the ground that he was in an old field.

[2] According to what was said earlier regarding cattle-raising and manuring, there does not appear to be anything prejudicial to the self-preservation of the Japanese forests in pasturing or withdrawing the bed of leaves.

found from Yezo to Southern Kiushiu, there appear constantly towards the south and lower altitudes, more evergreen trees. Among them evergreen oaks, camellias and other Ternströmiaceæ, the camphor-laurel, and some varieties of cinnamon are the most noticeable. On Shikoku and the peninsula of Yamato the camellia is found with the beech, deciduous oak and some kinds of maple. In Hiuga I saw Illicium religiosum and evergreen Daphne shrubs in company with Quercus cuspidata. In still other parts of Southern Kiushiu and reaching to 300 meters above the sea, we find, near this and other kinds of evergreen oaks, lofty trees of different species of cinnamon, and among others, Buxus japonica in the underwood.

We must, however, classify all these forests under the head of wild or natural, for they are not the product of any cultivation for a particular purpose, but grow independently. We can find also in all of them another and still more interesting feature, This is their marked relationship to the woods of the Atlantic States in North America, and to the forests of the tertiary period in middle Europe. It does not lie within the purpose of this work to consider more closely their kinships, and is the more unnecessary here, as those who are particularly interested in them will find a full account of them in vol. i. pp. 168–174.

Hitherto I have treated only of the natural deciduous forests of the mountains. I must note here, however, a group of Coniferæ which connects itself more or less with the deciduous forest and in general within the altitudes of from 1,500 to 2,000 meters. Where the last height is exceeded (up to 2,400 m., see vol. i. p. 157) the development of the trees is far behind the normal state, except where the ground of an old crater or a ridge gives protection from the violent winds, and affords a better soil. For example, *Abies Tsuga* and *A. polita* are found from 3 to 6 meters in height near the peak of Nantaisan, 2,500 meters high, in the Nikko Mountains while the same species, of no greater age, grow four or five times as high lower down. Of the six most common conifers in this region, Tsuga is without doubt the most frequent, and by itself often covers a wide extent of territory. With it one finds *Abies firma* and *Larix leptolepis* in the lower, *A. polita, A. Alcockiana*, and *A. Veitchii* in the higher elevations.

As a rule, only a few deciduous varieties of trees are found in these dark, high mountain forests (Kuro-ki, or Black Forests), and these are only exceptionally brought to a high state of development. They are birches, alders, and mountain ash (*Betula alba, Alnus viridis, A. incana, Pyrus sambucifolia*), with different kinds of shrubs.

Apart from Yezo, the relative proportions of the entire Japanese Coniferæ, are given by Dupont[1] as follows:

[1] "Les Essences forestières du Japon," p. 8.

Resinous timber, and woods used in manufactures—(Bois de travail resineux) 35 per cent.

Deciduous timber, and woods used in manufactures—(Bois de travail feuillus) 5 per cent.

Deciduous woods for fuel—(Bois feuillus pour chauffage) 60 per cent.

This proportion, according to what has been said before, must be very nearly that of the pine forests to the deciduous forests, so that my conclusion as to the preponderance of the latter (vol. i. p. 151) is confirmed by Duport. The designation "Bois feuillus pour chauffage" must be taken in connection with what I have said regarding mountain deciduous forests, that their greatest use consists in furnishing a supply of wood for charcoal. For it is evident that the demand for fuel is not so great in Japan as to consume 60 per cent of its forests. On the other hand, Japanese wood-culture is not limited to forests, as we see in Kiri (*Paulownia*).

No thorough investigation of the Phyto-geography of Yezo, comprising also the high mountains, has hitherto been made; but in comparison, we learn from F. Schmidt that on Sachalin, the Dwarf-fir region, the Pinus parviflora, which in Hondo is only found on the high mountain peaks, in some places grows as high up as 320 meters.

My studies in the plant-geography of Japan led me to make a classification of forest trees, especially Coniferæ, in Honshiu particularly, according to five zones of vegetation (vol. i. p. 157); two years later, in his "Ueber den anatomischen Bau des Holzes der wichtigsten japanischen Coniferen,"[1] which I have already quoted, and under the heading, "Beschreibung der japanischen Waldflora," Dr. Yaroku Nakamura of Tôkio, made a similar zone classification. As his differs somewhat from mine I give the two together in conclusion without further comment.

"Rein, Japan, vol. i. p. 157.

If we sum up in conclusion what has been said as to the forms of vegetation in Japan, and in particular as to the vertical distribution of its conifers, we may distinguish five zones.

1. *Zone of Pine-Woods and Juniper* to a height of 400 meters. It embraces the region of cultivation, the vegetation of the sand-dunes, of stagnant and slowly flowing water, of the bushy hill-country and of the

Nakamura writes: If we consider the vertical distribution of forest trees in Japan, we are able to classify them in general in five zones.

1. *Zone of the Pine Woods.* This reaches a height of 500 meters. The lower portion is inhabited by Pinus Massoniana, with the winter-green foliage trees such as Quercus acuta Q. glauca, Q. gilva, Q. phylly-

[1] "Untersuchungen aus dem forstbotanischen Institut zu München." III. Berlin, 1883, pp. 17–45.

evergreen forests in the south, which only in exceptional cases extends 200 meters higher.

2 *Zone of the Cryptomeria, Cypress and Yew*, 400–1,000 meters high. This is at the same time the range of the lower summer-green forest, in which the vegetation develops its greatest strength in point of luxuriance and variety of kinds, the region of Chestnuts, Deciduous Laureniæ, most of the Magnoliaceæ, Ternströmiaceæ, Lardizabaleæ, Hydrangeæ, Caprifoliaceæ, and other abundantly represented tribes, as well as, finally, the district of the lower and most widely distributed Hara.

3. *Zone of Abies firma and the middle broad-leaved forest*, 1,000–1,500 meters high. To this belongs the greater part of the deciduous forest consisting of oaks, beeches, maples, alders, ashes, horse chestnuts, aralias and the upper Hara.

4. *Zone of Firs and Larches.* 1,500–2,000 meters. It is also the district of the higher broad-leaved forest, composed of birches, alders, sub-Alpine plants and shrubs.

rhoides, Q. glabra, Cinnamomum Camphora, Distylium racemosum, Cinnamomum pedunculata, Buxus sempervirens, etc. In the upper parts (300–500 m.) Pinus densiflora with deciduous trees like the Zelkowa Keaki, Ginko biloba, Quercus dentata, Q. serrata, Q. crispula, Castanea vulgaris, Melia japonica, Sophora japonica, Aphanante aspera, Celtis sinensis, Populus Sieboldi, Ilex crenata, etc.

2. *Zone of the Cypress*, 500–1,000 meters high. The predominating varieties of wood are: Chamæcyparis obtusa, Ch. pisifera, Podocarpus macrophylla, Sciadopitys verticillata, Podocarpus Nageia, Torreya nucifera, etc.

3. *Zone of the summer-green foliaceous trees*, 1,100–1,700 meters high. Here are to be found principally Magnolia hypoleuca, Cercidiphyllum japonicum, Evodia glauca, Ulmus Campestris, Alnus Maritima, Fagus sylvatica, Juglans Sieboldi, Æsculus turbinata, Acer palmatum, A. cratægifolium, etc.

4. *Zone of the Firs and Larches*, 1,700–2,400 meters high. In the lower part of this zone are Abies firma, Larix leptolepis, and Abies Tsuga principally, and in the upper portion, are to be found Abies Veitchii, Picea Alcockiana, P. polita, etc.

5. *Zone of Dwarf-pine,* from 2,000 meters upward, the region of creeping Ericineæ and high Alpine herbs.

5. *Zone of the mountain Dwarf pine,* 2,400 to 2,800 meters high. Here the Pinus parviflora finds its home and the dwarfed Alnus viridis, Sorbus aucuparia, Betula alba, Alnus firma, etc. also appear.

The great influence of forests upon climate has been repeatedly called in question, but still more often abundantly attested. A short, appropriate statement of the relation between them, based on reliable observations, and from so competent an authority as the Russian meteorologist A. Woeikof, in Petermann's Reports,[1] was surely therefore welcome to many. The result of the investigation justifies the ruling, and among our foresters the unvarying opinion, that forests have really a strong climatic influence upon the country. The most eminent French *savants* have applied themselves to the question of reclothing the mountains of southern France and Algiers with forests, and have come to the conclusion that the cultivation of forests and all forms of vegetation has a powerful effect upon climate. They purify the air, cool it in summer, moderate the cold in winter, in many cases condense the moisture of the atmosphere,[2] and cause the greatest variety of rainfall. They suck up snow-water and rain[3] into their leaves, moss, and decaying matter, like the dry spongy turf. They lessen the formation of clefts in the ground by erosion and floods. On the one hand, they hinder the flooding of valleys in the time of heavy rains and melting of the snow; and on the other, the water they draw in and store away is given out gradually and feeds the springs in the dry season. Thus the forest becomes a water reservoir and an inexhaustible source of moisture, through which the depth of rivers is regulated and maintained.

The consequences of forest destruction show themselves not only in the failure of wood for fuel, building, and manufacture, but in still greater degree in the very considerable climatic changes which the country undergoes.

The destruction of forests causes an increase of the mean annual temperature, especially of summer heat, as well as a decrease of the annual rainfall. But to consider this as generally the cause of floods would be to judge too partially. Floods are known in the most densely wooded parts of the earth, especially in the heavily wooded districts of Japan. The terrible overflow of the Rhine in 1882 occurred in one of the richest forest districts of the central

[1] Petermann's "Mitth." 31 Bd. 1885, pp. 81-87.

[2] Every morsel of moss which we destroy, and indeed all foliage, is a reservoir for water.

[3] Forests do not attract the clouds, as has been popularly supposed, owing to deceptive appearances, but produce them, by condensing the air which moves through and over them.

mountains of Germany. The broad vestiges of the old river beds show too that our rivers of to-day have grown much tamer and better behaved, as well as that floods were much more common when Germany had still its primeval forests than now. But the correct explanation of this lies in quite another direction, and does not at all contradict the fact that the destruction of the mountain forests has materially increased the dryness of the atmosphere, the inequality in the distribution of the rainfall, and the danger of floods in the valleys. It is evident that it was not so much the quantity of the rainfall that formed one of the principal causes of these floods, as the forests in the plain, which later gave way to arable and meadow cultivation. The washing away of ground had not been so great nor the river beds so deepened as now, while numerous obstacles to a quick ebb of the waters presented themselves.

The destruction of mountain forests is looked upon by all scientists in these days as a calamity to the future of a country. With the wood, the decayed soil, with its covering of moss and leaves, goes inevitably from the mountain sides. The rain torrents and the wind sweep them away and leave only the naked rock. The weather-beaten mass thus broken off is carried rapidly to the valley, where floods and boulder-deposits frequently take place on the formerly cultivated ground. Numerous examples of the consequences of forest destruction, reaching on to future generations, are to be seen in different countries. In the year 1879 a Russian newspaper contained the following:

"One can wander for twenty or thirty hours on the coast of the Black Sea, which was in earlier time covered with oak woods, without finding a single tree. The once richly wooded environs of Tiflis are now entirely treeless. This is even more true of the mountain ridge of Daghestan, whose forests have been taken for the firewood of steamships in the Caspian Sea. The soil of Eriwan was once most productive; rich cornfields alternated with meadows between forests. To-day all is a desert waste, and the inhabitants can scarcely secure the most necessary food."

In the foregoing may be found much that is applicable to the situation in Japan. The weal and woe of the inhabitants in the valley depends to a certain degree upon the mountains and their forests and the improvement of rivers and making them navigable appears to be a problem which can only be solved satisfactorily in connection with a thorough system of mountain forestry. The preservation and scientific cultivation of mountain forests is one of the most important duties which the Japanese government has to perform for the good of the country. Their preservation serves to regulate the profuse rainfall, to protect the land from floods at the season of rain and thaw, and to provide the soil in the dry season with a rich water supply to fill the rivers. Their cultivation on the other hand aims to provide the needed wood supply, and to open to the country a source of income which till now has been very insufficiently valued and developed.

As in every system of forestry, so in the Japanese, there must be the aim to strengthen the better growths and repress more worthless timber, as well as to secure a proper marketing by establishing roads and means of transportation. A wide field of labour, but one rich in results, especially in consideration of the lack of wood in China, opens here—a work that certainly cannot be accomplished off-hand, but which must be carefully and steadily prosecuted. In my travels through Japan, I was often asked by those in government circles, what I would especially recommend for the promotion of the national welfare. I said then, and repeat it now, as of first importance—"To protect and cultivate the forest."

The Nature and Use of the more important Forest Trees and other useful Japanese Woods.

There are only a few works of real value upon this subject at my command,[1] with the exception of longer or shorter lists of Japanese designations with or without scientific names. I have therefore been thrown for the most part upon my own observations, the collections made during my travels, and an exhibition of fifty different kinds of wood made by the Minister of the Interior (Naimushio) in Paris, 1878, and which later on were sent to me.

The long duration of winter limits the period of most vegetation, in Yezo to five, in Middle Japan to six, and in the southern part to seven months of the year. It interrupts too the growth of all woods, even the evergreen. They show therefore distinct annual rings, as is the case in all countries where a low winter temperature and a regularly recurring standstill in growth takes place. For the same reason, there are scarcely any heavy woods such as abound in the tropics. In addition to all the other differences in the numerous woods of Japan, their specific gravity fluctuates between 0·329 in Kiri (*Paulownia imperialis*) and 0·960 in Tsuge (*Buxus*

[1] Thunberg, in the preface to his "Flora japonica," 1784, gave the first catalogue of the useful woods of Japan. His classification is followed by von Siebold in the already often quoted work, "Synopsis Plantarum Œconomicarum Universi Regni Japonici." Batavia, 1830. In this work he enumerates 39 species as Ligna maxime quæsita. The following works on this subject are of much more value:

1. "Preliminary Catalogue of the Japanese Kinds of Woods," by Dr. Geerts. "Transactions As. Soc. of Japan," vol. iv. pp. 1–26.
2. "Experiments on the Strength of Japanese Woods," by R. H. Smith. Ibid. pp. 27–28. 134 kinds.
3. "Les Essences forestières du Japon," par Dupont. Paris, 1879.
4. "Nippon Juboku-shi. Treatises on 100 Japanese woods, with lengthwise and cross sections." Published by the Geographical Department.

japonica, J. Müller).[1] Besides box, the heavier and harder woods of Japan comprise Yusu (*Distylium racemosum*), the varied Ternströmiaceæ (Camellia, Tea plant, Stuartia, and others), the Sarasuberi (*Lagerströmia indica*), different kinds of plum, and the numerous oaks, which have a specific gravity generally from 0·750 to 0·850.

Some of the most valuable trees of Japan attain an enormous growth. These giants are very rarely found in the forest, but generally in the neighbourhood of towns, in the courts and groves which surround old temples, and among the trees giving shade along the roads, especially those leading to celebrated temples. The Japanese admires and protects them and even transfers to them something of the reverence toward age which was instilled into him from his youth up. Among leaf-bearing trees, those most noted for size are the camphor-laurel and the Keaki; among conifers, the Cryptomeria and Ginko. A short classification of those giant specimens that I have myself seen may be of interest, and not out of place here.

1. Camphor-laurel (*Laurus Camphora*, L.) or Kusu-no-ki. A specimen that I saw at Kaseda-mura in 1875, on the way from Wakayama in Kishiu to the monastery-town Kôyasan, at breast-high was 11·5 meters in circumference. Like an old village linden, the trunk separated somewhat higher up into a number of mighty outspread branches. In the park at Uyeno in Tôkio I measured, in 1874, another camphor tree which rivalled the surrounding conifers behind the temple of Gongesama, and at 1 meter high showed a circumference of 5·50 meters. In 1884 Lehmann[2] found the circumference 5·55 meters, and the height of the tree he estimated at 31 meters. Large as these dimensions are, they are far behind those of the trees which one sees in Nagasaki and in other parts of Kiushiu. Kaempfer mentioned in 1691 a camphor tree which was celebrated for its enormous thickness. In 1826, 135 years later, Siebold found it rich in foliage and apparently sound. The trunk, which measured 16·884 meters in circumference, however was hollow.

2. Keyaki (*Zelkowa acuminata*, Planchon). At Meguro in the neighbourhood of Tôkio, in January, 1874, the "Ô Keyaki" (Great Keaki) was felled, and showed a circumference of 11·7 meters at 1 meter high.

3. Camellia (*Camellia japonica*, L.) or Tsubaki. In Southern Japan I saw many trees from 8 to 10 meters high, and 1 meter

[1] R. H. Smith gives the specific gravity of box as only 0·839; of Paulownia, as 0.329, and of Kashi (*Quercus dentata*, Thunb.) 1·017. There is no doubt an error in this, especially concerning the weight of Kashi, for the boxwood of Southern Japan is as marked above all others for its weight, as is Kiri for its lightness.

[2] R. Lehmann, engineer, of Tôkio, in accordance with an expressed wish of mine in 1884, kindly subjected several other trees which I had indicated to him to a careful measurement.

in circumference. The plants in their wild condition reach the same height but not the same thickness of trunk. A magnificent specimen in the court of the temple at Yutenji near Tôkio, with straight trunk and beautifully formed crown, I estimated in 1874, by its shadow, at 5 meters high. The trunk had a circumference of 1·47 meters. In 1844, Lehmann found the latter 1·53 metres and the height 5·5 meters. The age of the tree was given him as 120 years.

4. Shii-no-ki (*Quercus cuspidata*). A specimen behind the Sannô temple was, in 1874, 4·6 meters in circumference but scarcely 12 meters high, although this species is reckoned among the tallest oaks of Japan.

5. Fuji (*Wistaria Chinensis*, S. and Z.). There was a giant tree at Nakanobu-mura near Tôkio, which covered the spacious courtyard of a tea-house, and bore thousands of long soft clusters ot blossoms, but it has disappeared. Below its branching and at breast high it measured, in the spring of 1874, 2·45 meters around the trunk.

6. Sugi (*Cryptomeria japonica*, Don.). On Sasa-no-yama-tôge, on Kôshiukaidô (road from Tôkio to Kofu), about 750 meters above sea level, I found in the autumn of 1874, on the right of the road, a Cryptomeria, which at 1½ meters high had a circumference of 9·41 meters. Specimens of from 6 to 7 meters circumference are frequent in Nikko and other temple groves. They reach a height of 30 to 45 meters. In 1565 the missionary Almeyda visited the temple of Kasuga near Nara. The way led through an avenue of cedars (Sugi) and pines "qui faisoient une fort belle symétrie, et dont les têtes se joignoient tellement que le soleil n'y pouver percer." Single cedars measured "cinq brasses de circumference," or 8·12 meters according to modern measurement. He found the roof of the temple resting on ninety columns of cedar (Cryptomeria) trunks, each of which measured 6 meters in circumference.[1]

7. Ichio or Ginkiyo (*Ginkgo biloba*, L.). Among the trees of this kind in temple grounds in and around Tôkio, the largest and most finely developed is the one at the temple Koyenji. Ten years ago, at 2 meters high, its circumference was 7·3 meters, and in 1884 nearly 7·55 meters. Lehmann estimated the height of the stoutest branches at 32 meters, and heard that the age of the tree was supposed to be 1,000 years. This must, however, be a great exaggeration in view of the origin and growth of the city Yedo under Tokugawa Iyegasu, and the circumstance that the Salisburia only grows from planting. The tree has otherwise the appearance

[1] John Booth of Klein Flottbeck near Altona, mentions in his interesting report of the Forestry Exhibition in Edinburgh, 1884, that in the Japanese Reports concerning the province of Kiushiu (where?), it was stated that there were Cryptomeria groves in which single trees had a diameter of 27 feet. I should have at once substituted circumference for diameter had not the farther statement been made that they (Morimasa Takei and his companions), to the number of twelve, once passed the night in a hollow trunk.

of an old linden with a symetrically developed crown. In the park at Shiba the largest Salisburia had in 1874 a circumference of 6·30 meters.

8. Kôya-maki (*Sciadopitys verticillata*). The largest specimen which I know and which Japan can properly show, is found in a temple court in Nikko. Lehmann, who reckoned the height 24 meters and the circumference at 4·15 meters, was told that the tree was 250 years old, an estimate that agrees very well with the age of the park in which it was found.

Further estimates also in respect to immense size will be found in the following pages, in which I have tried to collect briefly in systematic order the most remarkable of the useful woods of Japan.

Fam. Gramineæ, Group Bambusaceæ.

The greater wood-forming varieties of bamboo cane, which alone are to be considered here, bear the collective name Take, in com binations often written "dake," for which also the Japanese-Chinese form chiku [1] is much used.

1. *Bambusa arundinacea*, L. (*Arundo Bambos*, L. and Thunb.), Japanese Ma-take or male bamboo. It is the most valuable and the most cultivated Japanese variety, with which *B. vulgaris*, Wendl., is often found in company.[2] Its cylindrical stalks are long and straight, the wood is firm, capable of resistance in the highest degree, and well adapted to many uses. Ha-chiku seems to be a sub-species. Ma-take reaches in Japan a height of from 15 to 20 meters and a trunk circumference of 40 to 50 cm., but only in favourable soil. In less favourable conditions and higher altitudes the dimensions will fall far short of the above figures.

2. *B. agrestis*, Poir. (*B. spinosa*, Roxb.), Japanese Kan-chiku, grows 6 to 8 meters high and over a thumb's thickness. It is a strong, thick-walled cane, that is distinguished chiefly by its knotty joints. It is found generally as a live hedge.

3. *Bambusa* ——? Japanese Môsô-chiku and Honan-chiku. The latter name comes from the Chinese province of Honan where,

[1] As most of the Japanese bamboos never produce seed nor even bloom, their classification and identification with Indian varieties is difficult. For this reason authors of works on the Japanese Flora, like Franchet and Savatier, have either omitted them, or contented themselves with simply giving the Japanese names. I have endeavoured to find in the well-known Treatise of Col. Munro, "A Monograph of the Bambusaceæ," in the Transactions of the Linn. Soc. vol. xxvi. pp. 1–159, a definite classification, but I give here the result with all reserve, and commit it to a successor who may better discharge the difficult task, and shed more light on this interesting subject.

[2] Of all the bamboos of Indian origin these two are found most widely spread. The former was in 1730 introduced into hot houses in England, and was till 1813 the only one of its kind there. In the West Indies, on the Mascarenes and elsewhere, both are now extensively cultivated.

as at Hong-kong, it is much cultivated. Stouter, but not so tall as *B. arundinacea*, it may be identified chiefly by the club-like swelling of the stalk at the base, and its frequent knobs. The wood is not so much prized, is porous and not so capable of resistance. It is used for flower vases and other vessels, but the principal object in its cultivation is to furnish bamboo sprouts in spring.[1]

4. *Phyllostachys nigra*, Munro (*Bambusa puberula*, Miq.), Japanese Kuro-dake, black bamboo, and Goma-dake. This variety shows brown spots when young, and becomes later quite black. It is a beautiful cane, from 3 to 6 meters high and of a thumb's thickness, but is not extensively cultivated. A kindred or only subspecies is the so-called Han-chiku, or spotted Bamboo of the island of Yezo. This is found near the western coast of Shikotan in Shiribeshi, where it grows in great quantities on both banks of a brook, and on account of its beautiful marking (irregular brown spots and shading) is much gathered. The Japanese prize it highly and use it for walking sticks, whistles, brush handles, and other objects.

5. *Arundinaria japonica*, S. and Z., called Me-take (*i.e.* female bamboo). This is an indigenous variety which is found growing wild in the hilly country, and much prized for thick-growing hedges. It attains a height of 2 to 3·5 meters, and a finger's thickness, is firm and hardy, used for whistles and brush handles, and has found a wide field outside of Japan.

Most of the other indigenous bamboos do not become woody, but remain small and grass-like. They bear the collective designation Sasa, often form the underwood of forests, and are distinguishable in part by the variegation of their leaves, and several varieties are found as decorative plants in Europe, for instance *Bambusa nana*, Roxb., *B. Fortunei*, van Houtte, *B. aurea*, Sieb., *B. pygmæa*, Miq., *Phyllostachys bambusoides*, S. and Z., *P. Kumasasa*, Munro.

The monsoon district is the old home of many kinds of bamboo and the place where the largest and most beautiful varieties are cultivated most extensively, as is also the case with rice. A portion of these bamboos have spread far beyond the tropic of Cancer, especially in China and Japan. Notwithstanding this, I cannot agree with Wallace when he affirms[2] that the immense grasses which we call bamboo cane can scarcely be regarded as tropical plants. The most numerous and especially the largest varieties belong to the tropical monsoon district, and those indigenous to South America and Africa seldom if ever cross the tropic line. No other food plant in monsoon lands is as important as rice, and no other wood growth equal to the bamboo (I consider here only

[1] *Bambusa quadrangularis*, Fenzi., Japanese Kaku-dake (square, four-cornered bamboo cane), Ciko-chiku, and Ho-chiku. (See Th. Dyer. "The Square Bamboo," *Nature*, vol. xxxii. p. 391.)

[2] Wallace, "Tropical Nature," London, 1878, p. 52 ff.

the large varieties) in respect to its varied use. None other graces the landscape with equal charm.

In their early growth the bamboo varieties furnish a favourite food ; in fuller development their decorative groups are most effective in the landscape of the country, and finally when dead they yield a material which in the warm monsoon districts is so manifold in its uses that an intelligent companion of Col. Yule[1] could not conceive of the possibility of human existence in a country destitute of bamboo cane.

As the houses in North Germany are decorated at Whitsuntide with the lovely green of young branches of birch, so in Japan the bamboo is used for the New Year's festival. Behind the fir tree on each side of the entrance door, is placed a tall slender stalk of Take-no-ki with its many knots and articulations, a symbol of man's strength, and its branches decked out with small mandarin oranges, according to old custom.

These great bamboo canes have often been aptly compared with asparagus. As every spring a number of stalks are driven up from the asparagus root, and under normal conditions attain a regular growth each year, so it is with the well ordered cultivation of the bamboo. Only here the circumstances are on a much grander scale. Out of a few clumps of bamboo roots on good soil is developed an entire grove. In early spring the fresh growth looks much like gigantic asparagus, and like it is used as a vegetable. By the 1st of May the canes of *Bambusa arundinacea* have reached the height of a man, but it is not till Midsummer that nature shows her full power in the bamboo thicket, for the cane is indeed grass, which one can see grow, in the literal sense of the word, and under certain conditions, at the rate of ten or more meters a week. Without branches or leaves, it forces its way easily through the thickets of other canes, and after reaching almost its full height, pushes out its thin branches through the nodes in all directions, forming of them and their light green foliage the web of its crowns which are already outlined. It is necessary of course to provide a bamboo plantation with plenty of light and air. The older canes which have been sawed off or hewn down are taken away and used, and young plants take their place. The larger cultivated varieties of bamboo in Japan, are not, as in India, set apart in forests by themselves, but, as has been previously intimated, are planted on the edges of forests, near large towns, and in temple groves. Experience has taught that most varieties, even in their Indian home, when they grow in groves of more or less density, sometimes from 20 to 30 m. high, only over-topped by the highest trees, or planted near villages, are very slow in reaching their blossoming and seed time, when they die. In Japan, the large cultivated kinds never blossom, nor do they here attain the same height and thickness as in their tropical home.

[1] Yule, "Marco Polo," i. 298.

In India, *Bambusa Brandisii*, Munro, sometimes grows from 30 to 36 m. high, and in warmer China, *B. arundinaceæ* and *B. vulgaris* reach a circumference of from 28 to 30 English inches (70 to 75 cm.), and a height of more than 20 m., dimensions which are considerably exceeded by the best canes of Japan.

The tree-like bamboo finds a use in every size, at all ages, in great quantities and for manifold purposes. First of all, the full-grown stalks, gigantic wood stems, which nature has endowed with many valuable properties such as no other wood possesses in like measure, have a wide range of applications and in numberless directions. No other wood contains so much firmness, elasticity and strength. The large quantity of free silicic acid in the cane makes it hard and able to resist many influences which destroy other wood. In burning it crackles and fulminates, as was noted by Marco Polo, who also mentions that wild animals in this way are kept at night from the camp fires and the fruits of the field. Its slenderness and length, its pipe form, its nodal interruptions and its easy lengthwise cleavage, are among its most valuable properties. Every attempt to number the manifold uses based upon these properties seems vain, for, sleeping or waking, in every form of activity and at every age, man is surrounded by its forms and accustomed to its uses wherever the bamboo grows in Southern and Eastern Asia.

In its natural condition, and stripped only of its crown, it is used for ladder beams, rafters, palings, posts, and stakes for protection and support, for example, of young trees ; for scaffoldings ; for rudder-posts, masts, flag-staffs, fishing-rods, and measuring sticks ; for walking-sticks, handles and other parts of implements and weapons ; for hedges, fences and all sorts of framework. Its hollowness makes it applicable in many directions, *e.g.*, as water pipes when the partitions at the joints have been pierced through, and for pumps, flutes, and whistles.

Every section with these cross walls at the joints is a closed vessel. If cut crosswise it affords a piece of pipe which, with its closed end and open top, forms a cylindrical vessel that may serve under different circumstances as a pail or cup, flower vase or spittoon.

Its easy cleavage allows of its use in small staves, splints and bands of various size, also chopsticks, spoons, spears, and other simple articles, as well as in many kinds of lattice work and plaiting, as hats, sieves, baskets, boxes and cages, chairs, litters and bedsteads, mats and covers, blinds for doors and windows, sails, picture-frames, screens and fans.

In Tôkio there are whole streets where there is scarcely anything but bamboo sold. Here, exposed for sale in the courts of the larger shops are thousands of stalks of every length and thickness, from rafters and ladder beams to paint-brush handles, ready to make up into the before mentioned Take-mono (bamboo work).

After what has been said of the various uses made of it by the inhabitants of the monsoon countries, and taking into account its ornamental features, it will not cause surprise to know that its praises are much sung by Chinese and Japanese poets. It is a favourite subject with the Japanese artist, which he imitates not only with his brush but the chisel also—and to be able to represent its characteristic likeness with a few strokes of the India-ink pencil is considered in Japan an unmistakable sign of artistic ability.

FAM. PALMEÆ.

6. *Chamærops excelsa*, Thunb., Jap. Shuro or Shuro-no-ki, also called Shuro-gi. The wood of this palm is especially valuable on account of its durability and resistance to damp, and is prized above all others in boat and house building. It is also used like bamboo in making hollow ware.

7. *Cycas revoluta* Thunb., Jap. Sotetsu. This beautifully spotted but very light and porous wood is distinguished for not splitting. It is used like Keyaki, for small boxes, plates, and other similar articles. (See Hakone-zaiku.)

FAM. CONIFERÆ.

a. *Taxaceæ*, Yew tribe.

8. *Taxus cuspidata*, S. and Z., Jap. Araragi, Ichii and Suwô, called by the Ainos, Onko—a bush or low tree six meters high, found mostly in Hida and on Yezo, and used often as a decorative plant. Its highly valued wood is marked by a beautiful red colour (like our yew), fine grain and great toughness. On account of this last quality it is used by the Ainos for their bows.

9. *Torreya nucifera*, S. and Z. (*Taxus nucifera*, Thunb.), Jap. Kaya (see p. 157), is mostly found as a bush and underwood, and seldom as a small tree. The wood is uniformly firm and thick, light-coloured, yellowish, and serves as building material and for chests and boxes.

10. *Cephalotaxus drupeacea*, S. and Z. (*Taxus baccata*, Thunb.), Jap. Inu-gaya (see p. 157). The wood is used like the foregoing varieties, but is not so fine-grained and is less prized.

11. *Ginkgo biloba*, L. (*Salisburia adiantifolia*, Smith), Jap. Ichio and Ginkiyo, must be considered a unique specimen among existing conifers, on account of its leaf, blossom, and plum-like fruit forms. Kindred specimens have been found in the Dogger-formation and were widely scattered over the northern hemisphere in the tertiary period, but are now reduced to the single Gingko of Eastern Asia. It is now known only in a cultivated state. The Chinese and Japanese cultivate it partly on account of its edible fruits (p. 94), but principally for the adornment of their temple

courts and cemeteries. It grows rapidly, reaches large dimensions and a great height. The wood shows many similarities to the maple, is of a bright yellowish colour, fine-grained, capable of polish, tender and easily broken, and therefore not so highly prized.

12. *Podocarpus macrophylla*, Don. (*Taxus macrophylla*, Thunb.), Jap. Maki, Kusa-Maki and Inu-maki, is limited to the warmer portions of Japan, and even here is not widely spread. Sometimes the plants are used for green hedges as here and there in Tôkio. It is mostly, however, met with in temple-groves and courts. It is a tree with a straight grey-barked trunk, 1 to 2 m. in circumference and 15 to 20 m. high. The fibrous, reddish yellow wood is not so durable in the air as in water, and on account of its scarcity, is not very widely used.

13. *Podocarpus Nageia*, R. Br., Jap. Nagai. As to its distribution, what was said of the preceding species is true also of this; indeed it seems still doubtful if it belongs to the indigenous conifers of Japan at all. The trees in the neighbourhood of temples resemble juniper in colour of their wood and their brownish red bark.

b. Cupressineæ: Cypresses.

14. *Juniperus chinensis*, L. (*J. Thunbergii*, Hook), Jap. Ibuki and Beni-biyakushiu. This Japanese juniper is a mere shrub, like all others. The reddish brown, firm, heavy wood is characterized by a strong and agreeable smell and is excellent for inlaid work, but on account of its small size and the difficulty of working it up, is not much used.

15. *Biota orientalis*, Endl. (*Thuya orientalis*, Thunb.), Jap. Konote, Wabyakudan. The fine-grained wood of this bush or low tree is but little used. It is like that of the Nagi, only lighter in colour and weight.

16. *Chamæcyparis obtusa*, S. and Z. (*Retinispora obtusa*, S. and Z.), Jap. Hi-no-ki.

17. *Ch. pisifera*, S. and Z. (*Retinispora pisifera*, S. and Z.), Jap. Sawara.

18. *Thujopsis dolabrata*, S. and Z. (*Thuju dolabrata*, Thunb.), Jap. Hiba.

These three conifers form a small group not so much on account of their relationship to Arbor vitæ as because of their conditions, common occurrence, the similarity of their woods and its uses. We find them chiefly on the mountain sides and in the low valleys of Honshiu in the Upper Kisogawa, and in Kishiu and Yamato, (see p. 219), upon a soil which having been made up by the decomposition of granite, of old slate, or volcanic rock, affords easy drainage and a deep rooting of the tree. In dense groves on a good soil, they form magnificent cultivated forests with straight upright trunks, reaching a circumference of 3 to 4 m. and a height of 30 to 35 m. When from 160 to 200 years old they look as sound as in their youth. Trunks 200 years old measure 2·5 to 3 m. around at the base; and 18 m. higher, where the crown commences, they are 1·8 to 2 m. in circumference. Hi-no-ki and Sawara are more often found than Hiba. When, as is generally the case, they are met with together, it is difficult at first glance to distinguish between them, while the third variety is very divergent in appearance. The fine yellow-green of the upper side of the leaves, the blue-green and peculiar marking of the under side in Thujopsis dolabrata, are so strikingly distinctive of this most beautiful of cypresses that we cannot easily confound it with other conifers.

As has been previously said, the cypress forest is a cultivated one. The seeds germinate best in the shade, which fact must be duly considered in the cultivation.

First of all in its value stands Hi-no-ki, which is particularly sacred to ancestry cultus (Shinto worship), and is cultivated on this account more than any other. The wood is white or pink, smooth, light and very tough, fine grained, poor in resin, and free from knots. It is preferred for lacquer ware, and used exclusively for building Shinto temples. The palaces of the Mikado and his family at Kiôto were always built of Hi-no-ki wood, and roofed with the bark of the tree, which when very old can be easily cut into long strips. Criminals condemned to Harakiri (disembowelling) were formerly presented with a dagger upon a small white unlacquered table of Hi-no-ki wood, and on a similar one is offered the food and drink to the gods at festivals.

Sawara is distinguished in appearance only by a rather light green crown, and on nearer observation by the different shape of its small scale-like leaves and its wood, strikingly different from that of Hi-no-ki, being of a reddish colour, rough, and not so valuable.

The wood of the Hiba is yellow, is marked by its durability in water, and is therefore much used for stakes, as well as in ship and bridge building. It is also employed in the same way as the before-mentioned varieties for lacquer wares and window sashes or Shoji, for which use, however, Hi-no-ki is much preferred to both the other varieties.

Various kinds of the previously mentioned cypresses have more interest for the gardener than the forester. The following are notable only for their wood:

19. *Thujopsis lætevirens*, Lindl., Jap. Nedjuko, which is often taken for a smaller form of the Dolabrata, from which it is distinguished among other things by a bluish green colour. The wood is fine and straight-fibred, similar to the former varieties, and like them adapted to manifold uses, but does not rank in value with Hiba. In its white sap-wood it is very similar to Hiba, but in dark brown core it resembles more the Sugi.

20. *Cryptomeria japonica*, Don., Jap. Sugi. While Hi-no-ki is indeed the most valuable, Sugi is without doubt the most widely employed of all the conifers of Japan. Young specimens are used

for evergreen hedges, and its finely developed trees are to be admired in temple groves and avenues (see illustration in vol. i. p. 150). It is most frequently found forming larger or smaller cultivated forests throughout the entire empire, from the islands of Riukiu to Yezo, for it is a marvellous wood producer and serves for house-building as well as the manufacture of boxes of all sizes.

The Cryptomeria are not so ornamental when young as many other pines. And the trees must be seen at their full growth in order to be able to appreciate their favour in temple groves and along the roads leading thereto—gigantic figures frequently 5 to 6 m. in circumference and often tall, perpendicular shafts 20 to 25 m. high which raise their dark green, regular, conical heads from 10 to 15 m. higher.

From earliest years they blossom every spring and bear fruit abundantly, but an after-growth is seldom seen in the Sugi forest any more than in the Hi-no-ki wood, so that the variety would probably die out if it were not for human interference. It is akin in this to the giant Sequoia of California, to which it has, in habitat, also much similarity. It is cultivated from slips and seedlings, chiefly from the latter. The tree demands a deep soil and protection against storms. We find its forests in the valleys and on mountain sides to about 1,000 m. high. In plantations on a light clay soil the ground must be carefully treated like arable land, deeply ploughed and freed from all weeds. The seeds sown in rows in the autumn sprout the next spring. At the end of the second year the seedlings reach a height of 0·50 to 0·60 m. and are transplanted in the following spring. Sugi grows rapidly. Four-year-old trees have an average height of 1·80 m. and in a good soil their circumference will be 0·45 m. in ten years, and in fifty years 2 meters.

The wood of the Cryptomeria is brownish red at the core, sap-wood white, easily split, of agreeable smell, easy to work, durable in water, but also very brittle. The colour changes very considerably with its growth and its condition, from bright red to a dark reddish brown, like the walnut. This colour also distinguishes the sub-species known by the name of Jindai-sugi, while Yaku-sugi shows a brownish red, fire-striped colour, and Kurobe a reddish brown. On account of its beautiful colour and ease of working it is preferred for most purposes to that of pine and fir, and is higher in price. It is not therefore used in bridge building nor in other places where elasticity and strength to bear heavy weight is necessary. The English usually call the Cryptomeria Japanese cedar, and built great expectations on its cultivation forty years ago, when first introduced by Fortune. These expectations have been as little fulfilled, however, as in other places north of the Alps. The tree is very sensitive to severe cold and long summer coolness, while the dry, hot climate, *e.g.*, of the Canaries suits it well. In Germany it grows in only a few protected places, like the Heidelberg Castle park and in the neighbourhood of Bonn (Rosenburg), where one specimen has attained a height of 20 m. in twenty-four years and is 0·85 m. in circumference at the height of 1 meter.

c. Abietineæ: Firs, pines and larches. The Japanese collective name for the last two is Matsu, while several kinds of firs are called Momi. Of the nine varieties of Japanese firs and pines given by Franchet and Savatier in their "Enumeratio plantarum," only two have any wide distribution, or as wood producers any significant value, viz., *Abies firma*, S. and Z., and *A. Tsuga*, S. and Z.

21. *Abies firma*, S. and Z., Jap. Momi, is spread over the whole of Japan, more general however in Middle and Northern Hondo, and on the Southern Islands. It is found chiefly and in the highest development in mixed forests, among the beautiful deciduous woods, at an elevation of between 1,000 and 1,500 m. seldom isolated. It develops the most magnificent trunk of all the Japanese firs, and grows in parks and temple groves to a height of 30 to 40 m. with a circumference of 4 to 5 m. In its entire bearing as well as in the character of its wood, this tree resembles our *Abies pectinata*, but has a much slower growth. Its wood is lighter, rougher, and less tough than that of the pine, hence cheaper and less valued. It is seldom used in housebuilding.

22. *Abies Veitchii*, Lindl. (*A. nephrolepsis*, Maxim.), Jap. Shirabe, a tree of the upper conifer region with a greyish red bark which is distinguished from kindred species chiefly by the brilliant, bluish white colour of two lines on the under side of its needles, thus giving its crown a peculiar appearance. It grows 20 to 30 m. high and measures about 2 m. around the trunk. The wood is moderately fibrous, splits easily, has broad shining rings of white and narrow reddish autumn zones, and is lighter and still less elastic and firm than that of the Momi, and consequently not so much prized.

23. *Abies bicolor*, Maxim. (*A. Alcockiana*, Lindl.), Jap. Tohi, belongs likewise to the high mountain conifers of Middle and Northern Hondo, but is often found on Yezo. This tree, which as a rule is found mixed with the following species, attains the same dimensions as Shirabe. Its wood is pale pink, white in the sapwood, less shiny than Shirabe, and seamed with large distinctly recognisable channels of resin. On account of its easy cleavage it is frequently used for shingles.

24. *Abies polita*, S. and Z. (*Picea polita*, Carr.), Jap. Ira-momi and Tora-momi. This kind is very easily distinguished from others by its needles, which are four-edged, prismatic in shape, crooked toward the top, and ending in a sharp point. It makes a fine stately tree with the bearing of our Abies excelsa, belongs to the high mountain districts and northern parts of Japan, and, like its previously described companions, is little used. In modern times on the island of Yezo, however, it has been much employed in building.

25. *Abies Jesoënsis*, S. and Z. (*Abies Menziesii*, Louv.), Jap. Yezo-matsu. This second kind of Yezo fir does not attain the dimensions[1] of the foregoing species, and is also less used. It is found on Yezo and Sachalin, as well as in the mountain pine-forests of Middle and Northern Hondo; here and there also as an ornamental plant in gardens and temple groves, where it reaches a height of 30 m., and a circumference of 2 to 3 m.

26. *Abies Tsuga*, S. and Z. (*Tsuga Sieboldi*, Carr.), Jap. Tsuga. The Tsuga fir is found on all the large Japanese islands, chiefly at an elevation of from 1,500 to 2,000 m. (region of firs and larches), and especially on the light soil of volcanic mountains. It grows usually in dense groves on a clear sod, with but few other trees in its company. It is seldom found so low as 700 m., but reaches there its best development, with a circumference of 3 to 4, sometimes even to 5 meters, and a height of 24 m. with a trunk 12 to 14 m. The finest specimens I found in the forest of Kirishima-yama, in Southern Kiushiu, with trunks 4 to 5 m. thick, growing with Momi of equal size. In the mountain pine-forests, the height and thickness decrease toward the top, especially the former, so that in places over 2,000 m. in height, the trunk falls off in height to about 6 or 8 m., as may be easily observed on climbing Nantai-san in the mountains of Nikko.

Wherever the Tsuga grows in forests by itself, it forms, like its North American relative, the hemlock tree (*A. Canadensis*, Michaux), a fine straight trunk, but when growing isolated it tends like this one to fork and become crooked. The wood has very fine qualities and is prized above that of all other firs in Japan. It has a reddish colour, is moderately fibrous, fine grained, resinous, firmer and tougher than the other pines and firs, and therefore more durable. It is also less influenced by changes in temperature and damp. On account of this property, and its resistance to moisture, it is used by the prosperous Japanese for the verandah floor of his house, and prized the more if it has a deep red colour. Its high price, however, due to the difficulty of working up, and also on account of the inaccessibility of the forests, and the lack of proper transportation, prevents any extensive use of the wood in house and ship building, to which it is eminently adapted.

27. *Pinus densiflora*, S. and Z., Jap. Aka-matsu and Me-matsu.

28. *P. Massoniana*, S. and Z. (*P. Thunbergi*, Parl.), Jap. Kuro-matsu and O-matsu. These two pines, belonging to the Pinaster Endl. group, are accounted among the most widely used and favourite trees of Japan. The first is very similar to *P. sylvestris*, and the second like *P. austriaca*. With the latter, as with Kuro-matsu, or the black pine, the colour of the bark of trunk and branches is dark grey all the way through, while Aka-matsu, the red pine, is marked, like our common pine, by the pale red colour of the upper trunk and branches.

[1] "Reports to the Kaitakushi," 1875, p. 306.

The Japanese, like the Chinese, to whom the monœcious character of this tree has long been known, describe the Kuro-matsu as male, and the Aka-matsu as female. Accordingly they call them O-matsu (male pines) and Me-matsu (female pines). At the New Year's festival it used to be the custom to place at the left of the wreathed doorways a black-trunked *P. Massoniana*, and at the right a red-trunked *P. densiflora*, to represent a happy marriage.

Pinus Massoniana makes the least requirements as to soil of any tree in Japan. If the sand dunes thrown up by the waves of the sea have attained some firmness through the settlement of deeply rooted strand plants, among which generally the creeping juniper, *Juniperus littoralis*, Maxim., is often found, the Japanese turn them to good use by plantations of Kuro-matsu. This pine is therefore of very much the same importance here as Pinus Pinaster in the French Département Des Landes, which has been previously mentioned. From the coast to 300 meters above the sea, we find the Kuro-matsu on land that would afford no support to other conifers. It comes to its best as a shade-tree on the country roads and in temple court-yards. Trunks from 150 to 200 years old, with a circumference of 4 to 6 m., and 30 to 35 m. high, are here not unfrequently found.

The appearance of Pinus densiflora resembles the foregoing species in many particulars. It grows in hilly and mountain districts 150 to 800 m. above the sea level, and in exceptional instances still higher, especially on the sunny slope of a mountain. Lower down, as on the roadways of the country, it is often found mingled with Pinus Massoniana, and like it, in scattered growth, so that there is plenty of light and air for many a shrub as underwood between the trees. It also inhabits the gravel soil formed from the slate of mountain sides, and granite splinters, old lava fields also, and does not attain the dimensions of the Massoniana.

Among all the conifers of Japan, the wood of these two, next to that of some of the firs, is the cheapest. The two are very similar in colour and marking, as well as in their long straight fibres, in closeness and toughness. They are much employed therefore in house and bridge building, for numerous little implements, and as wood for burning porcelain, and many other purposes. But, in comparison with the wood of our pines, they have no remarkable superiority. They are just as resinous and knotty, and only exceptionally as straight in trunk, being much more bent than our Pinus sylvestris in thin and open groves.

29. *Pinus Koraiensis*, S. and Z. (*P. Strobus*, Thunb.), Jap. Chosen-matsu (Korea pine), and Goyô-no-matsu (five-needle pine). The name given by Thunberg to this variety indicates its similarity in appearance to the North American white pine, while its cones, with their edible nuts, remind us more of *P. Cembra*. The tree had its origin, as is indicated by one of its Japanese names, in Corea, and is found in Japan only as an ornamental

tree. I saw in Northern Hondo, a beautiful avenue lined with it near the castle of Morioka (p. 94). The dirty, yellowish red wood has broad year-rings, and is used in much the same way as the before-mentioned pines.

30. *Pinus paroiflore*, S. and Z., Jap. Goyô-no-matsu and Hime-ko-matsu. This variety forms the underwood of the upper portion of the high mountains in Hondo and Yezo, and is occasionally an ornamental tree in gardens and parks. Its yellow wood is far behind all the other kinds in value.

31. *Larix leptolepis*, Gord. (*Pinus Larix*, Thunb.), Jap. Kara-matsu. The Japanese larch is found from the 34th parallel northwards. In Middle Honshiu it belongs, as a rule, to the mountain region between the levels of 1,500 and 2,000 m., and forms few settlements by itself, but is more often mixed with Tsuga and other sorts of Abies. Farther north its growth is limited to lower elevations, more and more, and with this the frequency of its appearance and even its development increase. It is especially adapted to a soil of crumbled volcanic lava, and in high altitudes measures 1½ m. around the trunk, and 20 to 24 m. in height. In peculiarly favourable lower-lying points it reaches a diameter of 4 m. and a height of 30 m. Its reddish brown core shows small year-rings, is fine grained, tough and durable; it withstands damp remarkably, and for these reasons is highly valued, though, on account of the difficulty of procuring it, is employed but little in building, but in preference in mining, as well as for small wares.

32. *Sciadopitys verticillata*, S. and Z., Jap. Kôya-maki. The Japanese umbrella pine is a fine conifer, unique in its bearing, and without question one of the most beautiful species for which we are indebted to Eastern Asia. Its proper name is Kane-matsu, or gold pine. Its name Kôya-maki, reminds us of Maki (*Podocarpus macrophylla*) which its leaves somewhat resemble, and of the monastery-town Kôya in Kiushiu, where the umbrella trees form a magnificent grove, and in the neighbourhood are found in several dense woods, at an elevation of 400 to 800 m. Here the tree is in all cases only artificially propagated, as has been proved. It grows straight and tall, with thick branches, as is the case with Pinus Strobus, to a height of 20 to 24 m., and a circumference of 2 to 4 m.[1] The cones remind one of pines, as do the fissured bark of old trees, and the outspread branches. But the crown is regularly cone-shaped, like most kinds of Abies, and that which lends a particularly distinctive character is its leaves, which are verticillate like the branches and twigs of pines, and long, like their needles. They are broad, thick, shiny and green like those of Podocarpus. The yellowish white, light, fine-grained and broad-ringed wood

[1] The incorrect statement of Siebold, that the umbrella tree grows in bushes only a few meters high, has been preserved and repeated in many of our books, although it was long since shown by Veitch that its development is that of a stately tree.

most resembles that of the different Abies varieties, and is not distinguished by any particularly valuable properties. This may be the reason why the umbrella tree is cultivated only on the Kôya-san, in forests, and but here and there as an ornamental tree.

Fam. Salicineæ.

33. *Salix japonica*, Thunb., Jap. Yanagi. The white, tender wood of this and some other willows, among them the ornamental weeping willow (*Salix Babylonica*, L.), called Shidare-yanagi, is used for making Yô-ji, or tooth-brushes; children's playthings, little dishes, cups, etc., are also turned from it. Willow plaiting has already been noted on page 173.

34. *Populus tremula*, L. (*P. Sieboldi*, Miq.), Jap. Yama-narashi, and Dorufu, if not so frequent as in Europe, is nevertheless to be found in the mountain woods of Japan, and especially in the clearings from the 34th parallel northwards. The wood is scarcely used.

Fam. Betulaceæ.

35. *Betula alba*, L., Jap. Shira-kaba or Shira-kamba, also called Kaba and Kamba, is found scattered in the high mountain forests of Middle and Northern Hondo, and upon the island of Yezo.

36. *B. ulmifolia*, S. and Z., Jap. Midzume, whose brownish red wood is like that of the alder. The wood of this and other kinds of birch is used sometimes for boxes and for lacquer-ware.

37. *Alnus firma*, S. and Z., Jap. Minebari, Yama-harinoki and Hari-no-ki.

38. *Alnus Maritima*, Nutt. (*A. Japonica*, S. and Z.), Jap. Hari-no-ki and Han-no-ki.

39. *Alnus incana*, Wild., Jap. Yama-hari-no-ki. The wood of this alder is used for boxes. In the Hakone mountains it has a peculiar kind of use and employment. (See Art Industry: Wood Turning.)

Fam. Juglandaceæ.

The trees belonging to this family have the collective name, Kurumi. Besides our common walnut, *Juglans Sieboldiana* is cultivated here and there on account of its fruit (p. 94), and the latter as well as other varieties is found also scattered in the mountain forests of Middle and Northern Hondo, as well as on Yezo. Their wood has varying character and value. It is used only moderately in joiner-work. The noteworthy varieties are:

40. *Juglans mandschurica*, Maxim., Jap. Kurumi, whose beautiful dark wood is very similar to that of our walnut, and the following:

41. *Juglans Sieboldiana*, Maxim., called Tô-gurumi and Kurumi.

42. *Pterocarya rhoifolia*, S. and Z. (*P. sorbifolia*, S. and Z.), Jap. Sawa-gurumi. Its wood is light in colour and weight, white, yellow-white, or bright pink.

43. *Platycarya Strobilaceæ*, S. and Z., Jap. No-gurumi and Yama-gurumi.

Fam. Corylaceæ.

44. *Corylus heterophylla*, Fisch., Jap. Hashibami. The white, soft wood is very little used.

45. *Carpinus japonica*, Blume, *C. laxiflora*, Bl., and *C. cordata*, Bl., all have the Japanese designation Soro. Their wood is white, shining, and like that of our common *C. Betulus*, little used.

Fam. Cupuliferæ.

We have here to regard first of all, the numerous Japanese species of the oak tribe. They are classified, as is well-known, in two groups; one, evergreen, with laurel-like leaves, smooth bark, found in the warm South and on the coast of Hondo northwards to the 36th parallel; the other in the North and mountain forests, deciduous, like our indigenous oak-group, having a thick rugged bark when old, and in general indented leaves. The former bear the collective name of Kaski, while the latter are called Nara. A great difference is seen in the two woods. That of the deciduous variety is like our oak wood, shows most distinctly pith-rays, year-rings and the characteristic concentric order of the large pores. In the laurel-leaved tribe these marks are less distinct; the numerous pores are smaller and more irregularly distributed. Its wood is correspondingly denser, firmer, tougher and heavier, and is therefore more valuable than that of the other. In comparison with most of the other kinds of wood which the country possesses, it is heavy, hard, tough and very strong, does not split easily, and resists the influence of moisture for a long time. The wood of the deciduous species is like that of the chestnut tree, mainly prepared as charcoal for fuel, and scarcely used at all in carpentry. That of the evergreen is prized above all where elasticity and toughness are especially in demand, and is used for handles, bearers' poles, oars, and in ship building. To the deciduous oaks of Japan belong:

46. *Quercus dentata*, Thunb., Jap. Kashiwa. This species is distinguished chiefly by its very large indented and serrated leaves, and is often grown on this account as a small ornamental tree for gardens. It is especially numerous on the island of Yezo. I found it as a shrub very often in the Hara on the border of the volcanic mountain forests in Northern Hondo. Its large-pored wood is of small value.

47. *Q. crispula*, Blume, Jap. Ko-nara or Nara, a small-leaved, deciduous oak, resembling our own in bearing and in wood, as do those immediately following. It is very widely spread, grows

singly as far as Southern Kiushiu, is found in the middle and northern portions of Japan, often in groups, and with a circumference of 3 to 4 m.

48. *Q. glandulifera*, Blume, Jap. Nara, O-nara, Midzunara, is like the foregoing and often found in its company. The leaves however are much larger, as is indicated by the name O-nara, great oak. Both have a fine wood like ours, but do not reach the same imposing dimensions.

49. *Q. serrata*, Thunb., Jap. Kunugi and Kunugi-nara, very widely distributed on Yezo and Hondo, also in Corea and China, as well as in the Indian slopes of the Himalayas to a height of 1,500 m. (See Brandis, "Forest Flora of India," p. 486). The leaves are very like those of the edible chestnut and are the food of the oak-spinner silkworms. (See Silk Culture, p. 210.)

Among the many evergreen oaks, the following are most prominent:

50. *Q. cuspidata*, Thunb., Jap. Shii-no-ki, of all the evergreen Japanese oaks, is the least susceptible to the cold of winter; it is the most widely spread and most important, often forming dense forests, *e.g.*, in the vicinity of Atami at the foot of the Hakone mountains. It furnishes a valuable wood. It is a great favourite as an ornamental tree, especially in Tôkio. In spring, when the leaves change, the tips of its twigs are white and red with young leaves, which little by little become a deep green. In May it puts forth catkin blossoms, which in colour and position more resemble those of our edible chestnut than of the deciduous oak. The edible acorns (Shii-no-mi) have been already mentioned on page 94.

51. *Q. acuta*, Thunb., Jap. Aka-gashi, red oak. This tree derives its name from the redness of its wood, which deepens often to a reddish brown. It is rather more susceptible to cold than the foregoing, and sometimes has a trunk of considerable thickness.

52. *Q. glauca*, Thunb., Jap., Shira-kashi, *i.e.* white oak. This wood is the lightest in colour of all the Japanese varieties, grey-white, very dense, firm, tough, and therefore much prized. It is preferred for making lance handles, bearers' poles and rudder posts, as well as handles to various implements. The Shira-kashi loves a warm climate, and only in the mild South develops to a sightly tree.

53. *Castanea vulgaris*, Lamark, Jap. Kuri.[1] The light brown wood is used in the forests for making charcoal; but is otherwise not much in demand. In its structure it is like the foregoing oak, but is more porous, lighter, and less durable.

54. *Fagus Sieboldi*, Endl., resembles very much our ordinary beech, and is probably only a variety of the same. The Japanese call it Buna. Its distribution and importance in the Japanese

[1] For further particulars concerning this variety, and its distribution, see p. 93, also p. 210.

mountain forests have been mentioned on page 218. The fresh wood is greyish white but grows darker and redder by degrees. Its numberless fine pores are evenly distributed. It is distinguished from the oak by its firmer structure and finer grain, but is not so heavy, nor so tough and durable. Easy cleavage, hardness and flexibility are its chief properties. It is used here and there for agricultural implements. Soup bowls are made from it and then lacquered, but it is seldom used for fuel.

Fam. Moreæ.

35. *Morus Alba*, L., Jap. Kuwa. On page 190, this tree and its cultivation have already been considered in connection with silk culture. The wood may be called but a secondary product Its year-rings are outlined like those of the deciduous oak by a girdle of large spring spores. It has lengthwise fibres, generally of a yellow colour, sometimes reddish brown, and is in this latter case more highly valued. It is firm and durable, takes polish easily, and is, within a limited range, used in joiner's work.

Fam. Ulmaceæ.

56. *Zelkowa Keaki*, S. and Z. (*Planera acuminata*, Lindl.), the Keyaki (pronounced Kéaki) of the Japanese, is a stately and, because of its wood, a useful tree, found in forests and temple groves as well as along the side walks of village streets, particularly in the neighbourhood of Tôkio. It sometimes reaches prodigious size, from 30 to 40 m. height and 10 m. circumference. In appearance it resembles very strongly Celtis australis of the Mediterranian regions, as for instance the fine specimens of this kind in the Botanical Garden at Madrid. But it is also similar to our beeches.

Keaki is the favourite joiner's wood, and plays in Japan the part of oak wood with us, and is somewhat like it. Its most notable recommendations are, that it does not split nor warp easily, so that cross sections may be used, *e.g.* for trays and bowls, as is done in the Hakone mountains. It is also noted for its great toughness, elasticity and durability, as much in water as in dry air, if not felled when full of sap. The smooth grey-white bark resembles in colour and thickness that of our beeches; the soft, light-coloured sap-wood is quickly transformed into grained wood, whose colour varies according to the situation and age of the tree, from light to dark brown. To make it more valuable, the colour is often deepened by a long submersion in water before working. Keaki is lighter than oak, having a specific gravity of only 0·682. When cut crosswise its small pith-rays are easily distinguished, as is the case with all elms, and the girdles of numberless larger pores on the inside of the year-rings is plainly marked. These pores and their walls show very distinctly even when cut lengthwise. This reveals also the parallel and straight-fibred character of the ordinary wood. The illustration of the Japanese tobacco pipe-case on page 133 gives a good idea of the structure of keaki wood. It serves the Japanese for many purposes; in ship and house building, in furniture making, turnery ware, and for manufacturing many small articles. It takes different names according to its colouring, the highest estimate being placed on Tama-moku, or speckled wood, also called Tama-no-keaki.

In all the qualities which have been mentioned, it excels the other Ulmaceæ. On the other hand its branches are so fine and its foliage, like the Celtis, is so light, that it cannot be used like the elm as an ornamental or shade-giving tree. Its draft upon the soil is about the same as with its kindred. It is found in its best condition on light clay soil, in which it can spread and develop its roots symmetrically. It belongs to the lower region of the mountain deciduous forests, and in Hondo seldom grows beyond an elevation of 800 to 1,000 m. It is not widely distributed or frequent, and only attains on the plains, in temple groves and along the roads, those large dimensions which distinguish it beyond all other deciduous trees, except the camphor-laurel.

57. *Celtis sinensis*, Pers. (*C. orientalis*, Thunb.), Jap. Ye- (pronounced A)-no-ki. In its appearance this tree is like Keyaki, but does not reach such a growth, and has a light, greyish white, spongy wood, of little worth. The tree is seldom found in the forest, but is cultivated on the banks of streams and in villages.

58. *Homoie celtis aspera*, Bl. (*Aphananthe aspera*, Planch.), Jap. Muku, Muku-no-ki. The wood is darker, denser and better than that of the foregoing variety, but still is not very valuable. The tree loves a warm climate, but does not grow very large, often remaining only a bush. (For the uses of its inside bark, see Paper Industry.)

59. *Ulmus campestris*, Sm., Jap. Haru-nire, Kobu-nire, Ya-gire, The nature of this tree, so widely distributed in Europe, is well known. I have a wood specimen from the last Paris Exhibition, by the name Damo, its source, Shimotsuke-no-kuni, Hoso-Omura, in the province of Shimotsuke, which evidently belongs to this variety. It has greyish white sap-wood and reddish grained wood, and may be identical with the "Aka-tamo," *i.e.* red Tamo, named by Dupont in his book, p. 50, and which is often mentioned by others as wood of the island of Yezo. The Tanichi-tamo of this island appears to be *Ulmus montana*, Sm., the Ohio-no-ki, already spoken of.

60. *U. parvifolia*, Jacq. (*Microptelia parvifolia*, Spach.), Jap. Akinire, Nire, and Yu. This wood has finer pores and is denser than that of the others. The tree comes far short, however, of reaching their height.

FAM. BUXACEÆ.

61. *Buxus japonica*, J. Müll. (*Buxus virens*, Thunb.), Jap. Tsuge. There appears to be no material difference between this plant and *Buxus sempervirens*, L. The yellow wood is finer grained, denser and more uniform in structure, as well as heavier than all the other woods of Japan. Under the microscope it shows fine year-rings and pith rays, but not to the naked eye. The pores seem evenly distributed and remarkably fine. There is no marked separation of grained and sap-wood. Out of a collection of fifty different kinds of Japanese woods, each piece 150×75×3 mm. in size, the tsuga warped the most. The box tree is confined to the warm South, and appears oftenest on the Riu-kiu islands. Its much prized wood is used chiefly in the manufacture of combs, as mentioned already by Kaempfer and Thunberg.[1]

62. *Elæococca cordata*, Bl. (*Aleurites cordata*, Müll.), Jap. Dokuye, Abura-no-ki, Abura-giri, and Yama-giri (see pp. 156, 157). This plant shows great similarity to Kiri (*Paulownia imperialis*) in habitat, figure and size of leaves, also in quality, colour and use of its wood.

63. *Excœcaria japonica*, J. Müll. (*Croton siraki*, S. and Z.), Jap. Shira-ki and Haratoku.

64. *Sapium sebiferum*, Roxb. (*Stillingia sebifera*, S. and N.), Jap. Tô-haze and Nanking-haze.

FAM. LAURACEÆ.

The evergreen members of this interesting family are generally superb trees and belong to the warm south of Japan. The deciduous varieties (of the Lindera species) are found as bushes and low trees scattered everywhere in foliaceous forests. However different the colour and value of the woods belonging to this class may be, they are all more or less alike in aromatic odour, dull or high silky lustre, indistinct pith-rays, and even distribution of pores. The woods of the cinnamon species belong to the most valuable of Japanese woods. Their weight is less than that of the oak.

65. *Cinnamomum camphora*, Nees. (*Laurus camphora*, L.), Jap. Kusu, Kusu-no-ki. The most noteworthy qualities of this interesting and valuable tree have already been mentioned in the article "Camphor," pp. 143–150, and also on p. 225. When cut crosswise, camphor wood shows numerous, evenly distributed, moderately large pores, whose size and figure differs according to the age and situation of the tree. The colour of the wood also varies between greyish white and dark reddish brown, but is most generally a light brownish red. The various sorts of camphor wood are dis-

[1] "Ligni pro pectinibus conficiendis, quos portant feminæ crinibus infixos, rubro plerumque vernice obductos."—Flor. Jap. p. 77.

tinguished according to colour, the dark-coloured varieties, reddish brown and speckled, being most highly prized.

66. *C. pedunculatum*, Nees (*C. japonicum*, S. and Z.), Jap. Yabu, Tabu, Tabu-no-ki and Tama-gusu, or speckled camphor wood. This wood resembles the foregoing in its variety of colour, but is denser and heavier. It is still more valuable, especially in furniture making, for small cabinets and other articles, and furnishes a specially fine veneer.

67. *Machilus Thunbergii*, S. and Z. (*Laurus indica*, Thunb.), Jap. Nan, Inu-kusu, Ta-funo, growns not only in the southern islands, but also along the coast of Hondo as far as Tôkio.

68. *Litsæa glauca*, Sieb., Jap. Yabu-kusu, *i.e.* Camphor-bush, Shiro-tsudzu (Shiro-damo).

69. *Tetranthera japonica*, Spreng. (*Tomex japonica*, Thunb.), Jap. Hama-biwa.

70. *Actinodaphne lancifolia*, Meissn. (*Daphnidium lancifolium*, S. and Z.), Jap. Koga-no-ki, Koga-gashi. Eight species of the deciduous genus of *Litsaea*, Thunb. (*Benzoïn Nees*) are found in Japan. They are moderately sized bushes, which do not specially differ in foliage from many other members of the deciduous forest. Several take the name Kuro-moji, on account of their blackish bark; others are called Shiro-moji because of a greyish white bark. The first are found very far spread, even on the island of Yezo. In all varieties there lies around the white pith a greyish white, silky, fragrant wood, that on the cross-cut shows fine pith-rays, distinct year-rings and very small pores. For several hundred years the various kinds of Kuso-moji have been used for the manufacture of toothpicks, Jap. Ko-yôji (yôji, tooth brush; ko, small), especially the—

71. *Lindera sericea*, Bl. (*Benzoïn sericeum*, S. and Z.), Jap. Kuro-moji, and the—

72. *L. umbellata*, Thunb. (*Benzoïn Thunbergii*, S. and Z.), Jap. Inu-kusu, Kuro-moji.

Fam. Scrophularineæ.

73. *Paulownia imperialis*, S. and Z. (*Bignonia tomentosa*, Thunb.), Jap. Kiri or Kiri-no-ki. This tree is not indigenous, but one of the plants cultivated in Japan for its light wood. It is never found in groves only of itself, or otherwise like a forest tree, but is more like our fruit trees. It grows rapidly, and in the course of nine to ten years develops a good-sized trunk. It may be propagated by roots or seeds. The wood is usually of a greyish white, but often light brown, very porous, especially at the year-rings. In its specific gravity of 0·329, it approaches cork, but in comparison with many other woods of light weight it is remarkably strong, and does not warp nor split easily. All these properties increase its value, and on account of its lightness and softness it is used in hundreds of

ways; for the manufacture of boxes for pills, tooth powder, paper, cloths, bric-a-brac, also for *getas*, or wooden shoes, cabinet drawers, light and pleasing lacquer wares, playthings and many other articles.

Fam. Bignoniaceæ.

74. *Catalpa Kaempferi*, S. and Z. (*Bignonia catalpa*, Thunb.), Jap. Raiden-giri, Shira-giri. The wood is like the Kiri though darker, and similarly employed. The name Shira-giri, "White Kiri," comes from the light colour of the blossoms.

Fam. Oleaceæ.

75. *Fraxinus longicuspis*, S. and Z., Jap. Toneriko, like our ash, loves the deep, damp soil of the hollows and ridges of the valley. It is found in the mountain foliaceous forests from Kiushiu to Yezo, but most frequently of all in the North. Its wood resembles our indigenous ash, is of a greyish white colour, fine grained, with numerous tiny pith-rays and distinct year-rings. Each of these rings is sharply separated, by one or two rows of somewhat darker pores, from a compact girdle that encloses them on the outer side. The wood is much used in joinery for boxes, like that of both the foregoing species.

76. *Olea fragrans*, Thunb., Jap. Mokusei, an ornamental shrub in Southern Europe, and

77. *O. aquifolium*, S. and Z., Jap. Hira-gi, growing wild, and also an ornamental plant. It has a fine, whitish, and light brown marbled wood, which under the lens shows small pores, clear but close year-rings, and numerous small pith-rays.

78. *Ligustrum japonicum*, Thunb., Jap. Nedzumi-mochi, like the foregoing, a large bush or small tree, an ornamental plant, and growing wild. The yellowish brown wood is also similar, and is used in the same way for making boxes and other small articles. The same is the case with *Ibota*, Sieb. (*L. vulgare*, Thunb.), Jap. Ibota (see also p. 164).

Fam. Styracaceæ.

There are many members of this family in the different low mountain foliaceous forests of Japan. They are good-sized deciduous shrubs or small trees which in early summer are covered with five-pointed, white, bell flowers. The wood is distinguished by its close grain, hardness, and durability. It is used moderately in joiner-work and turnery. The most remarkable of all is:

80. *Styrax japonicum*, S. and Z., Jap. Chisha-no-ki, Yego. It is found extensively on the edge of forests, also in moats, and resembles, in its general bearing and the colour of its bark, a finely branching beech from 4 to 6 m. high. Its beautiful white, long-stemmed flowers form a row of bells hanging along the lower side of the branches.

81. *Styrax Obassia*, S. and Z., Jap. Oba-no-chisa.
82. *Symplocos lancifolia*, S. and Z., Jap. Ikono-shiba.
83. *S. japonica*, D. C. (*S. lucida*, S. and Z.), Jap. Kuro-ki.
84. *S. cratægoides*, Don., Jap. Tubetagi.

Fam. Ebenaceæ.

85. *Diospyros Kaki*, L., Jap. Kaki. The distribution of this beautiful tree, and its greatly prized fruits, the so-called persimons, has been already considered, pp. 88, 89. There remains only to note the qualities and uses of its wood. This is light greyish brown when young, like the kindred Indian ebony woods (*D. ebenum* and *D. melanoxylon*), and becomes black at the core only when old. This black Kaki (Kuro-gaki) is generally included in the Shibu-gaki or astringent Kaki (see pp. 181, 182). But, as with the Indian varieties, it is impossible to tell from the outside whether the black wood has formed, and this can only be determined by boring. When cut crosswise, Kaki wood shows small or moderately large, unevenly scattered pores, of a circular or elliptical form, and numerous very fine pith-rays. The specific gravity is less than that of the Indian ebony wood—only 0·606, according to Dupont. In this, as in firmness, it is far surpassed by oak. It is used in joiner-work, especially for veneer, small cabinets and boxes, glove boxes, etc.

86. *D. lotus*, L. (*D. japonica*, S. and Z.), Jap. Shinano-gaki and Mame-gaki. The wood of this wild variety resembles the foregoing, but has finer pores, and is closer. Its use is the same.

The wood of *Diospyros ebenum*, L., Jap. Koku-tan, was brought into Japan from South China and Further India, and is employed for similar purposes.

Fam. Ericaceæ.

87. *Rhododendron Metternichii*, S. and Z., Jap. Shaku-nage. The light brown wood of this high mountain shrub is close-grained and hard. It is used in Nikko and elsewhere in wood-turning.

Fam. Caprifoliaceæ.

88. *Viburnum opulus*, L. The wood has distinct year-rings, very fine pith-rays and pores, which even under the glass are hard to find. It has a pale pink or reddish brown colour.

Fam. Corneæ.

89. *Cornus officinalis*, S. and Z., Jap. San-shiu, San-shiu-yu.
90. *C. brachypoda*, May, Jap. Midzuki.
91. *Marlea platanifolia*, S. and Z., Jap. Uri-no-ki. The fine-grained wood of these bushes or low trees is used here and there for small articles.

Fam. Araliaceæ.

92. *Calopanax ricinifolia*, Miq. (*Acanthopanax ricinifolia*, S. and Z.), Jap. Se-no-ki, Shi-o-ji. This beautiful tree is distinguished by its great, lobate, shiny leaves, its white flower-umbels, and black fruit, of the size of pepper-corns, resembling, like its flowers, the Aralia and Ivy. Like Magnolia hypoleuca and Æsculos turbinata it is scattered in the high mountain forests of Japan from Kiushiu to Yezo,[1] but is most numerous in the North. In Yezo, trunks of from 3 to 4 m. circumference and 30 m. height may be seen. I often found them in Hondo quite as high, but generally not so thick. In high forests the trunks are often somewhat bent, and do not branch till they are 20 m. high. Their dark, thick, rugged bark makes them as noticeable as their beautiful foliage. The white wood shades often into brown, and is moderately light, rough-fibred, and more or less porous. Cross cut, it shows year-rings, but no pith-rays. The pores are of two kinds: one sort microscopic and scattered about in the thick summer-wood; the other apparent to the naked eye, and denoting the spring girdles. According to Böhmer, the Ainos make their canoes out of the large trunks from 6 to 9 m. (20′) long. They call the tree, he says further, Yoshini; the Japanese, Se-no-ki and Hari-giri.[2]

Fam. Lythrarieæ.

93. *Lagerströmia indica*, L., Jap. Saru-suberi, is said by Brandis[3] to be of Chinese extraction, and according to Gamble,[4] is often found as an ornamental plant in the gardens of India. In Japan, also, it is cultivated here and there, on account of its beautiful red flower-clusters. It is characterized not only by these, but by the fact that its brownish bark shells off of itself. It is a slow-growing bush or low tree, with a firm, fine-grained wood of a light pink colour. Cut across, the wood shows small pores, year-rings close together, and numerous pith-rays. It is used in turning.

[1] According to Böhmer in his "Reports to the Kaitakushi," 1875, p. 312, this tree grows best in Yezo, and becomes a tree of almost tropical appearance. F. Schmidt found fine, lofty trees in Southern Sachalin also.

[2] In the previously mentioned collection of woods, which the Japanese Government sent to the Paris Exhibition, 1878, there is a tablet of Satsuporo (Sapporo) from Yezo, bearing both these names; also a second marked Shi-oji, from the province of Musashi. They are both of a greyish white colour, but are not alike in structure nor in weight, as the Shi-oji is much the heavier. The Sapporo specimen has fine pores, and each year-ring shows only one row of distinct spring-pores, while the other has a whole girdle of irregularly arranged pores.

[3] "Forest Flora of North-west and Central India," p. 240. London, 1874.

[4] "A Manual of Indian Timbers," p. 200. Calcutta, 1882.

Fam. Hamamelideæ.

94. *Distylium racemosum,* S. and Z., Jap. Isu, Isu-no-ki or Yusu, belongs to the warm southern parts of Japan, and is mostly found in the province of Hiuga. It is also seen in the forests of the district of Obi, and there, according to Dupont, the trunk attains a height of 12 m. before branching, and a circumference of 3 m. I, myself, have often met the tree on Kiushiu and Shikoku, in gardens and temple-groves; but I have never seen specimens of more than 1 m. circumference and 15 to 18 m. high. The branches spread far out in all directions, if air and light permit, and the insignificant flowers appear in the earliest days of spring. The leathery, short-stemmed and elliptical leaves are frequently covered with galls the summer through, like our ashes and beeches. The bark and wood of the tree are highly prized. The former is smooth, thin, and of a grey colour. When the trees are felled the bark is peeled off, dried, and burned to get the ashes called Isu-bai, which are sent to the porcelain manufactories in Arita, where they serve in the making of porcelain glaze. The wood is shipped mostly to Ôsaka. It is specially good for making combs, but serves a variety of other purposes also, as it has many excellent qualities. It is heavy, fine grained, compact, strong, tough, and extremely durable, even in water, so that Dupont said of it, "On pourrait l'appeler le bois de fer du Japon." Its colour varies from light to dark chocolate according to its age. The cross-cut section when placed under the microscope seems thickly sown with small pores, but the year-rings and pith-rays are very indistinct.

Fam. Rosaceæ.

Nearly all the many varieties of this family have a reddish, compact, fine and close-grained inner wood, that takes a very easy and often beautiful polish. It is moderately heavy, its specific gravity ranging between 0·6 and 0·7. The most valuable wood of this family is obtained from

95. *Prunus pseudo-cerasus,* Lindl. (*P. puddum,* Will.), the Sakura or Yama-sakura. This is a fine tree of moderate size, resembling our cherry. It grows wild in the forests all over Japan and also in South Sachalin. On the great southern islands it is found here and there at an elevation of 1,000 m. above the sea. Farther north the altitudes in which it is found grow lower and lower. It is a favourite ornamental tree for the garden and the temple grove, where it is chiefly prized for its large, full flowers. Its even, fine-grained reddish wood is employed principally for carvings, and for blocks in printing cloth and wall paper.

96. *Prunus Mume,* S. and Z. (*P. armeniaca,* Thunb.), the Mume, or Bai. Wood generally dark reddish brown, like the foregoing, but not so highly prized. It has many fine pith-rays and clear year-

rings, each one separated from the other by a row of dark spots (pores). For further observations see p. 86. The woods of all the other fruit trees belonging to Rosaceæ enumerated on pp. 83–87. No. 11, are included in this variety.

97. *Amelanchier canadensis*, Torr. and Gray, Jap. Chide and Zaiburi, furnishes a wood similar to the Sakura, like it reddish in colour but much harder.

98. *Pyrus sambucifolia*, Cham., Jap. Nana-Kamedo, and

99. *P. aucuparia*, Gaertn., *var. Japonica*, Maxim., Jap. Yamanashi, both belonging to the upper boundary of the mountain forests, furnish wood of similar character.

Fam. Leguminosæ.

100. *Sophora japonica*, L., Jap. Yenju, is found scattered through the entire country, especially in the foliaceous forests of the north. It grows sometimes to a height of 18 to 20 m. and has a circumference of 2 m., for example, in Ôsaka where it is an ornamental tree, overshadowing an open space before a temple. It has long been cultivated in Europe also, and grows to a fine stature, resembling specimens of our Robinia. The wood is light, and varies in colour from light brown to a dark sepia. Its coarseness of grain and porosity make it less even and delicate, but it is very tough and durable. The year-rings show distinctly in the cross section, divided into light zones with very large pores, alternating with others darker, closer, and less porous.

101. *Gleditschia japonica*, Miq., Jap. Saikachi, a sightly tree found principally in Northern Japan. It grows wild along the rivers and in the hollows of the lower mountain forests, and is cultivated in the neighbourhood of the villages.[1] Its long brown pods were formerly used throughout the entire north of Hondo, for soap. They are found still in many of the shops of Morioka, done up in small packages. The wood of Saikachi resembles that of the Yenju.

102. *Albizzia Julibrissin*, Boiv. (*Mimosa arborea*, Thunb.), Jap. Nemu and Nemu-no-ki. The following description of this plant may be found on p. 139 of the first volume of this work. " In the island of Amakusa and the neighbouring Kiushiu, most of the deciduous trees were already covered with foliage in the second half of April, 1875; *Rhus succedanea*, L. and *Castanea vulgaris*, Lamk. had partly developed their young leaves, and only *Albizzia Julibrissin*, Boiv. (*Mimosa arborea*, Thunb.) still displayed their winter aspect unaltered, and even a month later, in the middle of May, we found this little tree in the mountain forests of Shikoku, at a height of some 800 meters, quite leafless, so that its Japanese

[1] I found it specially frequent in Nambu (Iwate-ken) and counted one day on the road from Kamaishi to Morioka nearly 100 trees near the village of Yokomachi.

name 'Nemu, sleeper,' suits it for other reasons than merely the sensibility of its leaves, and its sleeping during the night."

This little tree is spread abroad over the whole of Japan, and is also found in the Himalayas. The broad zone of its young wood is yellow, the core dark brown, hard and strong, also easy to polish. The cross-cut shows numerous firm red pith-rays and year-rings, with large pores and dark outlines.

The dark red sandal-woods of the tropical monsoon district belong also to this family, particularly the *Pterocarpus indicus*, L. and *Pterocarpus santalinus*, L. These two, with perhaps a third variety, the *Pterocarpus marsupium*, Roxb., were a long time since introduced into Japan, under the Sinico-Japanese name of Shi-tan. They are used for making furniture, and still more for carvings.

Fam. Anacardiaceæ.

103. *Rhus succedanea*, L., Jap. Haze, Haji, Haze-no-ki and Rô-no-ki (see p. 163). This wood is sharply divided by an irregular line and varying colour, into light greyish white sap-wood which resembles kiri-wood, and the moderately heavy core of a bright green colour. The latter has an extremely silky appearance when polished in longitudinal sections. Cut across the grain, distinct year-rings are seen, and a great many pith-rays and pores, which are larger and more numerous in the spring-zones than in the closer and darker summer-wood.

104. *Rhus vernicifera*, D. C. (*R. vernix*, Thunb.), Jap. Urushi or Urushi-no-ki (see pp. 158 to 163). The wood is similar in all respects to the foregoing variety, only considerably lighter and not so firm. It grows lighter in colour with age. Both kinds are used for making small chests, and the lining of cabinets and chests of drawers. But it has no great value. The rest of the Japanese sumachs remain much smaller, and their wood also is not remarkable and will not justify any special mention.

Fam. Acerineæ.

None of the twenty-two kinds of Japanese maple, distinguished mainly by their leaves and fruit, attain the size and height of our mountain maples (*A. pseudo-platanus*, L.), no matter whether they grow wild or as ornamental trees. The best known and most valued varieties are :

105. *Acer palmatam*, Thunb. (*A. polymorphum*, S. and Z.), Jap. Momiji. The scientific names of this variety refer both to the division and multiformity of the leaves. This is seen in the many varieties which grow in gardens and temple groves, and are peculiarly prized because the foliage at its first development in spring and before falling in autumn is of a magnificent red colour. The tree in all its varieties is of low stature, often even dwarfed.

The wild plant, which belongs to the lower mountain forests, grows about 12 m. high, and the trunk is from 1·5 to 1·8 m. in circumference.

The light greyish brown wood shows fairly distinct year-rings, very small pores and numerous weak pith-rays. It is extremely fine grained, even, close and heavy, therefore durable and tough, and on all these accounts belongs to the most valuable cabinet woods of the country.

106. *Acer Japonicum*, Thunb., Jap. Kayede or Kaide. The Japanese give this name to several other maples, such as *Acer micranthum*, S. and Z. The tree is found often in mountain forests as high as 1,000 m. above the sea, and grows as large as the foregoing variety. The light-coloured pink wood is fine grained, close, and when cut longitudinally shows a shiny spotted surface. A wood well known by the name Itaya, and found on Yezo, seems to be identical with *A. japonicum*, Thunb., and Yama-shiba with *Acer carpinifolium*, S. and Z.

Fam. Sapindaceæ.

107. *Sapindus Mukurosi*, Gaertn., Jap. Mukuroshi, a medium-sized tree of the lower foliaceous forest which, according to Gamble, is the same as the Indian *S. detergens*, Roxb. The wood of the Mukuroshi, like that of all the soap-nut trees, is of a light yellowish white colour, with fine pith-rays and a girdle of numberless moderately large pores. It is light, brittle, and not of much value.

108. *Koelreuteria paniculata*, Laxm. (*Sapindus Chinensis*, L.), Jap. Moku-kenjiu, Bodaijiu. This little tree is found in forests, but is often, as with us, an ornamental tree. Its wood is like that of the Mokurushi.

109. *Æsculus turbinata*, Bl., Jap. Tochi, Tochi-no-ki, a beautiful tree of the deep mountain forests, from Kiushiu to Yezo. It has yellow flowers, and deserves the attention of our gardeners, on account of its fine foliage. The wood is extremely fine-pored, whitish, brittle, and perishable, therefore, like our horse-chestnut, is not much prized.

Fam. Rhamneæ.

110. *Hovenia dulcis*, Thunb., Jap. Kempon-nashi, has been already mentioned (p. 87), as a fruit tree. The light wood has a colour varying from yellowish brown to brownish red. It is even in texture, finely porous, and shows in cross sections clearly marked year-rings, and numerous small but sharply distinct white and prominent pith-rays. It is found too seldom to have any great significance.

111. *Zizyphus vulgaris*, Lamk., Jap. Natsume and Sanebuto-natsume (see p. 87). The wood of this fruit tree resembles, and is

as scarce as, that of the foregoing. The very numerous small pith-rays are here widely separated and sharply defined.

Fam. Celastrineæ.

The woods of this family are characterized in Japan by a white colour, an even, fine grain, and great density. The pores are extraordinarily small and fine, and the numberless pith-rays also. These valuable properties, which resemble those of the box, make it to be regretted that the bush-like, imperfect development of all the varieties prevent any extensive use of the wood.

112. *Evonymus Sieboldianus*, Bl., Jap. Mayumi, is called Pai-oh-cha by the Chinese. It is said to be employed in wood-carving. (A very fine specimen of this variety, of even white colour, is shown in the collection at Kew Gardens.)

113. *Celastrus articulata*, Thunb., Jap. Tsuru-mume-modoki.

Fam. Ilicineæ.

Franchet and Savatier's "Enumeratio Plantarum" gives no fewer than thirteen species of this evergreen genus of shrubs and low trees. They are naturally, for the most part, confined to the South, and are favourite ornamental trees. They are known for their fine-grained, even, hard wood, of a light greyish white colour. The pith-rays are numerous and show a darker colour than the woody fibre. Longitudinal sections are sprinkled peculiarly with dark spots on a light ground. The wood is used for turning a variety of small articles, in making combs and chopsticks, and is very well adapted to these purposes. The noteworthy kinds are:

114. *Ilex crenata*, Thunb., Jap. Inu-tsuge, the commonest holly of Japan. It is found from the Riukiu to Yezo, a bush sometimes 6 m. high, but very often much less. Its small-leaved foliage resembles that of the box, whence it gets the name, Inu-tsuge, or dog-box.

115. *I. latifolia*, Thunb., Jap. Torayo, is found along the coast northwards in the vicinity of Tôkio. Here it is frequently found as a tree from 6 to 10 m. high, growing in gardens and temple groves. It is distinguished by its thick, leathery, large, smooth-edged leaves of shining green, and its thick ramification, which render it a highly ornamental shrub.

116. *I. integra*, Thunb., Jap. Mochi-no-ki and Tori-mochi is closely related to the preceding in character and distribution. The cross section shows year-rings and dark pith-rays, and the wide length-wise section a dotting of distinct dark spots.

Fam. Meliaceæ.

Japan has four members of this family, viz:

117. *Melia japonica*, Don., Jap. Sendan.

118. *M. Too-sendan*, S. and Z., Jap. Tô-sendan, or Chinese Sendan.

119. *M. Azedarach*, L., Jap. Ôchi, Sendan.

120. *Cedrela chinensis*, A. Juss., Jap. Chian-chin.

Among the many varieties of foreign plants which the botanist from the north meets in gardens and public parks of the Mediterranean region is a deciduous tree of considerable size of trunk, whose thick and rugged bark is like that of an old Robinia. Its light, irregularly branching crown and thick twigs, however, resemble the large sumachs. In May, there appear, before the large double-feathered leaves, a number of light blue flower-clusters, which in form, colour and smell resemble those of the Syringa. This is Melia Azedarach, which is extensively used as an ornamental plant, and is known in the English West Indies with no little exaggeration by the dignified name—"The Pride of India." India is really its home, from which it has been imported to Japan, together with another variety whose name Too-sendan (Too = Tô) indicates Chinese origin. The third species mentioned above is considered indigenous, but like the others is not widely spread in Japan. The near kinship of the three plants is shown by their common name Sendan.

They are trees of rapid growth, but are more remarkable for circumference than height. The wood, which ranges from a light brown to dark brick-red colour, is exceedingly soft. The cross section shows broad year-rings, whose almost purple girdles of closely crowded pores are sharply defined and intersected by numerous very fine pith-rays. It is used in joiner-work and for chests, although it is not very firm or durable when exposed to the air. Utensils of various sorts are also made from it.

The Cedrela, as its popular name, Chian-chin, indicates, is a rare, ornamental tree from China. Its sweet smelling wood resembles that of the Sendan, but has a deeper brick-red colour. It does not warp or split easily, and is used for furniture-making. In comparison with its American relative, *Swietonia Mahagoni*, L. it has not much value.

Fam. Simarubeæ.

121. *Picrasma ailanthoides*, Planch., the only Japanese specimen of this family, is found in the mountain forests of Hondo, and on the island of Yezo. The soft, white wood has not been used yet.

The Chinese "tree of the gods," *Ailantus glandulifera*, Desf., in spite of its French name—"Vernis du Japon"—is not found anywhere in the kingdom of Nippon.

Fam. Rutaceæ.

Most of the woods belonging to this order are known by their close even grain and whitish colour. The pores are evenly distributed, as are also the fine numberless pith-rays. The heaviest woods are those of the orange family, or Citrus varieties, mentioned on p. 89, 90, to which belong

122. *Citrus trifoliata*, L., Jap. Karatachi, a high, strong, thorny bush, used pretty much in live hedges.

123. *Phellodendron amurense*, Rupr., the Amurian cork-tree, and *P. japonicum*, Maxim., till lately found only in Northern Japan. I do not know their Japanese names and uses. The former has been cultivated with success as an umbrageous tree in the Royal Institute for Gardening at Potsdam.

124. *Orixa japonica*, Thunb. (*Celastrus orixa*, Miq.), Jap. Kokusa-gi. This large bush is found in the foliaceous forests of the lower mountain region, and in gardens, *e.g.* and around Tôkio. Its wood is but little used. The strong aromatic odour of the leaves is disagreeable to Japanese olfactories, hence its name, which signifies "Little stink-tree."[1]

125. *Zanthoxylon piperitum*, D. C. (*Fagaria piperita*, Thunb.), Jap. Sanshô,[2] like *Z. Clava-Hercules*, L., is furnished with thorns and spikes, as are many other kinds of this genus, which is known in the warmer parts of America also. Large numbers of blunt spikes and knobs of a grey colour show themselves on its usually not very thick bark. They appear in the cross-section brown in colour, and composed of concentric layers of a close cork-like mass. The yellowish white wood is very equal, fine grained, close and firm like box-wood. Cross-sections show clearly defined year-rings, extraordinarly fine pith-rays and very small, regularly distributed pores. It is worked on the turning-lathe in the Hakone Mountains, especially for making many small articles such as pretty cups for cigar ashes, which usually preserve the knobby cork-like bark, and which are imported into Germany.

126. *Evodia glauca*, Miq., Jap. Kiwada or Obaku. As the bark and appearance of Kiwada has already been described on p. 176 a brief notice of its wood will suffice here. The wood is much lighter than that of the other varieties of the family. It is very soft, of a light grey or brown colour, lighter and almost sulphur-yellow in the sap-wood, like its inner bark, though much softer. The moderately sized pores are especially numerous on the inner edges of the clearly marked year-rings.

Fam. Tiliaceæ.

127. *Tilia cordata*, Mill., Jap. Shina-no-ki and Bodaijiu, called by the Ainos Shibeshi (p. 170).

128. *T. mandschurica*, Rupr. and Maxim., Jap. Bodaijiu.

[1] From ko=little, kusai=stinking, ki=tree.

[2] Concerning the value of this bush for its spice, see p. 71.

Fam. Sterculiaceæ.

129. *Sterculia platanifolia*, L. (*Firmiana platanifolia*, R. Br.), Jap. Ao-giri, *i.e.* green Kiri. The light grey, spongy wood resembles Kiri and is similarly employed. Its cross sections show distinct year-rings, thinly sprinkled with pretty large pores, which increase in number toward the edges of the rings. The pith-rays are clearly marked by their white colour and are equi-distant from each other.

Fam. Ternstroemiaceæ.

The evergreen bushes and trees of this family, Ternstroemia, Cleyera, Eurya and Camellia, also the deciduous variety Stuartia, furnish an extremely fine grained, finely porous, close, firm, hard, and correspondingly heavy wood which, in all these qualities, resembles the Yusu (*Distylium racemosum*). Like the latter, this wood is used for combs and various turnery articles, including seals and other things which demand firmness and a fine grain. The woods of greater circumference belonging to the larger species (Stuartia and Camellia) are used for bearer's poles, handles, cylinders, and in wood-carving.

130. *Ternstroemia japonica*, Thunb., Jap. Moku-koku (pronounced Mokkoku). This is a good-sized bush found wild in Southern Japan, but much cultivated in gardens and temple groves. In the latter it plays the same part as the species which follows. Because of its sacred character and the similarity of its bright chocolate-coloured wood to that of the Yusu (*Distylium*), the bush is also called Bukku-yusu, *i.e.* the Yusu dedicated to the gods.

131. *Cleyera japonica*, Thunb., Jap. Saka-ki; a fine, evergreen shrub growing wild, like the foregoing, in the warmer parts of Japan. It is a favourite ornamental bush for gardens and temple groves, and is a sacred plant in Shintô, the worship of ancestors, like the Lotus flower and *Illicium religiosum*, S. and Z., in Buddhism. In certain celebrated temples, *e.g.*, the Kompira near Kotohira in Sanuki, numerous articles made from the wood are offered for sale; carvings and chop-sticks (Hashi), called Sakaki-no-hashi, as olive-wood trinkets are sold in the holy places of Palestine.

132. *Eurya japonica*, Thunb., Jap. Shira-ki and Mi-sasa-gi. This bush, found widely scattered through the monsoon district of South-eastern Asia, grows only three or four meters high. Its leaves are very like those of the tea-plant. It is often found as under-brush in the woods of Southern Japan, but more often in the thickets of wooded mountain-slopes.

133. *Camellia japonica*, Lin., Jap. Tsubaki (see also pp. 152, 153). The Camellia is everywhere indigenous in Southern Japan. It grows to a good-sized tree in the mountain forests of Kiushiu and Shikoku, often at an elevation of 800 m. above the sea; it extends into the deciduous forests, where it is distinguished for size

above all the other evergreens except conifers. It is found with the winter-green oaks on the south-eastern coast of Hondo as far as the 36th parallel, and as a large bush on the Bay of Yedo. The northern limit of its natural growth on the coast of the Japan Sea is the hill-country of Northern Echigo, about 38° N. latitude. I found it there in the pine and bush forests as a bush 1 m. high. In Southern Kiushiu trees of 10 m. high and 1·4 m. circumference are frequently seen. I found this size, however, only among cultivated trees. I saw here often also the parasite, *Viscum articulatum*, Burm. on its branches. In its wild state the camellia blossom is a simple red flower which never opens to the full, but remains half closed, like a tulip. This variety is cultivated solely for the oil, and only as far as the Tsugaru Straits. Both the single and double camellias are found in gardens and temple groves, the latter, however, in fewer varieties than with us. The blooming season begins according to the latitude, in January or February, and lasts until April. The colour of the wood changes gradually from a light grey or pink to darker shades. The bark resembles that of the beech tree.

134. *Camellia Sasanqua*, Sieb., Jap. Sasan-kuwa, a large bush (see p. 152) whose leaves and flowers are very much like those of the tea-bush. The blossom time is late autumn and December, as in the case of the tea-shrub.

135. *Camellia theïfera*, Griffith (*Thea Chinensis*, Sims.), Jap. Cha, Cha-no-ki (see p. 110 ff.).

136. *Stuartia monadelpha*, S. and Z., Jap. Saru-name and Saru-suberi.

137. *Stuartia serrata*, Maxim., Jap. Saru-name and Saru-suberi, like the foregoing, which however is much more frequent. The home of this plant is in the mountain forests, 1,000 to 1,500 m. above the sea, *e.g.*, in the mountains of Nikko, on Mi-kuni-tôge, and elsewhere. It grows to a tree from 6 to 12 m. high, has a smooth bark, but seldom a straight trunk. Among the other members of the mountain forests it is distinguished by casting off its bark in small pieces, as the plane tree does with us. In this respect it resembles the *Lagerstroemia indica* of the gardens, whence comes the common name, Saru-suberi, or monkey-slider.

Among the other deciduous Ternstroemiaceæ, the well-known ornamental bush, *Stachyurus præcox*, S. and Z., Jap. Mume-fuji, can scarcely be considered as a wood-furnishing tree, and there remains only the species Actinidia to be mentioned. Its character differs widely from that of the other members of this family. We have to do here with only a few simple-leaved, deciduous climbing plants, which belong for the most part to the mountain forests, and only resemble the evergreen Ternstroemiaceæ in their blossom. Their fruits are juicy and sometimes edible berries (p. 92). Their brownish wood, like that of most climbing and creeping shrubs,[1] is

[1] Many of them bear the Japanese surname, Tsuru, Tsuta and Katsura.

light and very porous. Cross-sections of it are used for Dobin-shi, or mats for little tea cups, and it is further used for turning various small articles. The most notable of these varieties are:

138. *Actinidia arguta*, Planch. (*Trochostigma arguta*, S. and Z.), Jap. Shira-kuchi, Shira-kuchi-katsura and Ko-kuwa.

139. *A. polygama*, Planch., Jap. Matatabi (p. 92).

140. *A. volubilis*, Planch., Jap. Tsuta-no-ki.

Fam. Magnoliaceæ.

The wood of the varieties belonging to this family are moderately light, equal, fine grained, soft, somewhat elastic, but not very durable. In the cross section sharply defined year-rings are to be seen, very fine, extremely numerous and evenly distributed pores, and fine, prominent pith-rays, also very numerous. The following varieties deserve special mention:—

141. *Illicium religiosum*, S. and Z., Jap. Shikimi (pronounced Skimmi). This small tree is found wild in Southern Japan, is cultivated in gardens, and especially in the neighbourhood of Buddhist temples. In April it displays its numerous sweet smelling yellowish white blossoms. The vases of Buddhist temples are adorned with its branches, as those of the Shinto sanctuaries with Sakaki. The bark of the Shikimi (Shikimi-no-kawa) is used as described on p. 136 to make the quill-like brown Makko, or incense candles. The wood is employed in making chopsticks, and in turning.

142. *Magnolia hypoleuca*, S. and Z. (*M. glauca*, Thunb.), Jap. Hô-no-ki. This fine, highly interesting tree appears in all the mountain foliaceous forests of Japan from Kiushiu to Yezo, not, however, collected together, but scattered about among other deciduous woods. Towards the north its frequency increases; it attains here, also, its largest dimensions, trunks of more than 2 m. circumference and 20 to 25 m. high. It is found, also, in the high foliaceous forests of Middle and Northern Hondo, on the island of Yezo, and even in Southern Sachalin. It rivals in height and thickness the other deciduous forest trees in its company, and all the other varieties of its own race, even the North American *M. grandiflora*. Few of its kindred endure the rigours of winter so well also.

Hô-no-ki loves a good soil, and grows best in the shade of high trees, especially the beech forests. Oaks, maples, ashes, and especially Æsculus turbinata, and Calopanax ricinifolia are frequently its companions, as has been before stated.[1]

[1] Dupont errs in his work, which has already been several times quoted, when he says (page 58) "On le trouve toujours associé au chataîgnier (Kuri)." On the contrary, I found the Hô but seldom in the company of the chestnut, which latter makes far less demand upon the soil, but much greater upon the light and heat. It loves sunny mountain slopes, but does not grow in the same high altitudes as the magnolia.

The smooth greyish white bark of the straight trunk, which in thick high forests is branchless to a considerable height, reminds one of the beech. The crown is formed of thick, widely spreading, but not so numerous nor so ramified branches, and its leaves and flowers give the tree a peculiar beauty. The former strongly resemble the leaves of the American *Magnolia tripetala*, Mich., especially in their prominence, but are much larger, viz., 15 to 20 cm. long, and 5 to 8 cm. broad. They are elliptical and smooth-edged ; on the upper side of a beautiful green colour, and underneath greyish white, as indicated by the name "hypoleuca." Every branch develops about ten leaves, which are crowded together in verticillate form near the end. In the midst of this beautiful wreath of leaves, there unfolds about the middle of May or beginning of June a splendid large white flower, with a pine-apple-like perfume. Even later in midsummer the Hô-tree presents a surprisingly beautiful appearance. When the wind sways the foliage of the magnolia-lined mountain side, and the lower side of the leaf is turned upward, the tree looks to one at a little distance as if it were for a second time covered with blossoms.

By October the trees are bare. The long ellipsoidal reddish brown fruit-capsules, with their pink seeds, soon follow the leaves. The seeds, like all of this species, soon lose their germinating power, which is probably the main reason why the Hô-no-ki is still a stranger to our European gardens.[1]

The Hô-no-ki in Japan surprises and delights every lover of plants, and it is easy to agree with Dupont when he calls it more ornamental than *Magnolia grandiflora*.

The light, greyish white wood changes gradually to a deeper shade. It is soft, easily bent, and elastic, and has a fine even grain, which makes it applicable to many uses. The wood engraver uses it in patterns for cloth printing, and the lacquerer finds it adapted to various small articles. The sides of the pretty, light and durable oval bread-baskets are generally made out of Hô-no-ki. Two thin strips of the wood are bent around the elliptical pinewood bottom, their sharpened ends bent over each other and glued, and tacked to the bottom board. Sword sheaths (Katana-no-Saya) were also formerly made out of Hô-no-ki. In Niigata and Yonezawa it is used as the groundwork of nearly half of all the lacquer ware, and from it is prepared the soft, fine-grained charcoal which is used throughout the whole of Japan for rubbing the lacquer, and for polishing the enamel of cloisonné ware.

[1] I have made repeated unsuccessful attempts to propagate this plant from the seed in Europe. All magnolia seeds sprout on their way through the tropics, and reach us with dried-up germ fibres. Out of a collection of badly packed and half withered small trees which I received eight years since, about half a dozen were saved in the Botanical garden at Marburg. Of these six, one was sent to Garden-inspector Lauche, one to Prince Troubetzkoi at Intra, and a third was given to the Botanical Garden at Frankfort.

143. *Magnolia Kobus*, D. C., Jap. Kobushi. This wood stands next to Hô-no-ki in abundance. It is found in Middle and Northern Hondo, also on the island of Yezo, generally in the plains, on river banks and edges of woods, and even in the lower mountain forests. It does not grow as high as the preceding, but broadens its crown still more, and forms a beautiful tree, which blossoms while it is putting forth leaves.

There are six other magnolias which are known in Japan, though not in sufficient numbers to have a value as wood-producers; *Magnolia conspicua*, Salisb. (*M. Yulan*, Desf. ?), *M. parviflora*, S. and Z., *M. obovata*, Thunb., *M. salicifolia*, Maxim., *M. stellata*, Maxim., and *M. compressa*, Maxim.

144. *Katsura japonica*, L. (*Uvaria japonica*, Thunb.), Jap. Sane-katsura, Binan-katsura and Kuro-gane-modoshi, *i.e.*, iron sumach, is a notable sumach variety of the foliaceous forest. In the autumn, before the leaves fall, it has a glowing brownish red colour. The long trunks, from a finger's to an arm's thickness, are distinguished by their cork-like bark and the flexibility of their wood, so great that it is often used instead of cables in small bridges, and in other cases where strong binding is required.

145. *Cercidiphyllum japonicum*, S. and Z., Jap. Katsura. Magnoliaceæ find their greatest representative in this beautiful tree of the mountain forests of Northern Japan. Its heart-shaped leaves resemble those of the Cercis-tree, as the name of its species might indicate. It grows to a height of 30 m., and a circumference of 4 to 5 m. in the warm part of Yezo, and is found also in Hondo of a similar size, but only exceptionally. It is marked by rapid growth, a layer of wood 4 to 5 cm. thick being the yearly addition to the trunk of old trees. A soil made up of crumbled clay-shale on a basis of volcanic material suits the Katsura best. Its light soft wood is darker than that of Hô-no-ki, is of a light red varying to yellowish brown, is capable of high polish, and used in furniture making, and for the same purposes as Hô-no-ki.

146. Umure-gi (vulgo Omore-gi), *i.e.*, fossilized wood, and Jin-dai-boku, or wood from the time of the gods, is a heavy, dark brown lignite. It is used for making numerous articles, such as plates and trays, adorned with mottoes, flowers, birds, and other decorations, which are sold in Nikko, Tôkio, and elsewhere. The wood, which looks like dark walnut, but fails in resemblance on closer investigation, is said to come from Sendai (Natori-gawa), hence the designation of these articles in Tôkio as Sendai-no-umure-gi-zaiku.

7. Gardening.

Size, Enclosure, and Character of the Japanese Garden.—Limited Expedients and Peculiarities of Gardening.—Dwarfing and Deforming.—Improvement of Species.—Variegation.—The Japanese Love of Nature and Flowers.—Flowering Season and other characteristics of the Flora.—Shade Trees.

Enclosed fruit and vegetable gardens, such as are usually found with us around the dwelling, are unknown to the Japanese. He plants his Yasai-mono (see p. 69) on the Hatake, or Sai-yen, the vegetable ground in the open field. He calls the fenced tree-nursery Uye-gomi, and the little ornamental garden, commonly behind the house,[1] Niwa (Sonô is the poetical expression) or Kô-yen. It is the Niwa which chiefly interests us.

Siebold says[2] that even in the large cities there is scarcely a house which has not its garden, or at least a court adorned with one or more evergreen trees. This idea has become very prevalent, but it is nevertheless erroneous. Extensive journeys through different portions of the three principal islands of Old Japan, and numerous observations in cities and country, have convinced me that only a small proportion of dwellings have any ornamental or particularly cultivated piece of ground about them, and that these are only to be found in the homes of the cultured and wealthy classes. The following Japanese couplet, which Dr. R. Lange has well translated into German, agrees with this observation :

> "Ob auch des Lenzes Macht an allen Orten sich zeiget,
> Findest du Blumen doch nicht blühend in jeglichem Dorf."[3]

Even the already noted substitute for a garden—the court with its few evergreen trees (more properly bushes)—although frequently seen, is still only an exception. The two shrubs which are found most often in these narrow courtyards are the Tôshuro (*Raphis flabelliformis*, Ait.), a kind of fan palm, about 2 m. in height, and even more generally, the Nanten (*Nandina domestica*, Thunb.), a bush which seldom grows more than 1 to 2 m. high. Its trunk, when old, is covered with rugged bark. It bears red berry clusters in winter, and is a favourite house-decoration at the New Year. It often furnishes a pattern to the ornamental work of Art Industry, its leaves being wrought in silk, the berries in glass, painted with red cinnabar. The Nandina grows wild in Shikoku.

The enclosures (Jap. Kaki) of gardens and parks differ greatly.

[1] Kô-yen-chi (public garden ground) is a temple garden, a sort of open park ; as, for example, those of Uyeno and Shiba in Tôkio.

[2] "Sur l'état de l'horticulture au Japon," p. 2. Leide, 1863.

[3] "Haru no iro-no itari itaranu sato wa araji | sakeru sakazaru hana no miyuramu."—Old Japanese spring-songs, translated and versified by Dr. R. Lange. Berlin : Weidmann'sche Buchhandlung, 1884.

They are whitewashed mud and stone walls, palings generally of bamboo cane, and quickset hedges (Ike-gaki). There is abundance of fine material for the last-named, but it is in many places not used, and often only to a very limited extent. The different conifers, particularly the Cryptomeria and Podocarpus, and many varieties of bamboo-cane, serve well in evergreen hedges, but not the beautiful Evonymus or Liguster, which are used so successfully in the Mediterranean region.

Quickset hedges are seen most often around the houses of the Samurai. They are generally very carefully cultivated and trimmed, and shut off a small garden from the street. Oftentimes a pretty bamboo paling takes their place, but in this case an evergreen thicket grows just behind it, so as to hide the modest dwelling as much as possible from the passers-by. In the spring of 1875 I saw in the Samurai quarter of the little city of Nojiri (province of Hiuga, in Southern Kiushiu), for example, a row of stately camellia-trees behind such a fence, growing 9 to 10 m. high, and some of them still blooming. Close beside them the light beautiful crowns of the tall bamboo-canes rocked in the wind. The yellowish green of the young leaves of the camphor-trees and evergreen oaks contrasted finely against the shiny dark green of the last year's foliage and the red blossoms of the camellias and azaleas. In Akita, high in the north of Hondo, I saw at another time the little front garden of the Samurai dwellings mostly surrounded by Kome-no-ko, or Iwa-yanagi (*Spiræa Thunbergi*, Sieb.). Karatachi (*Citrus trifoliata*, L.) and Mukuge (*Hibiscus syriacus*, L.) are more often used for hedges. The violet-blue, rarely white, blossoms of the latter appear in late summer and autumn. Karatachi is used evidently because of its strong protection, for its hedges are neither close nor have they a very beautiful foliage, as the leaves are not as large and fine in appearance as those of the other Aurantiaceæ.

As has been stated several times in the first volume of this work, Chinese civilization was introduced into Japan with Buddhism in the sixth century A.D., and found its principal support and fostering in the cloisters and temples of the land. It can hardly be doubted that flower cultivation and the art of gardening among the Japanese received their first impulse and encouragement from Buddhist priests. For many centuries the Chinese had cultivated the beautiful ornamental plants which were brought from thence to adorn altars and graves, temple courts and holy pools, gardens and parks; also the plants which, like the peony and lotus, were at the same time producers of valuable medicines. In the enjoyment of the beautiful appearance and prosperity of the foreign plants, interest in the indigenous flora increased also, and its finest specimens were gradually brought into cultivation and carefully reared. These indigenous plants were found to be numerous and choice, for, as has been amply shown in vol. i. pp. 135–174, Japan is one of those countries where Nature wears her most variegated and attractive dress. Later on, some of those ornamental plants which Japan had got from China were introduced into our gardens and hothouses, and were taken for indigenous, just as certain Chinese ornamental plants brought to Calcutta, and afterward to Europe, were supposed to be of Indian origin, and were named accordingly; *e.g.* *Rosa indica*, L., and *Chrysanthemum indicum*, L.

As the feudal system developed in Japan and, under the rule of the Tokugawa, the privileged classes enjoyed their prerogatives in peace, the parks surrounding the fortresses of the Daimios and their Yashikis in Yeddo became the gathering place of various ornamental plants which had been introduced gradually from the neighbouring continent, and principally of those which had been borrowed from the splendid indigenous flora.[1] Every Samurai cultivated as large a selection as space would permit in the little garden which was his pleasure-ground, but the nationality of the plants after so many digressions was unrecognisable.

The Japanese ornamental garden is not intended to be an abode, but merely to please the eye. It is not a pleasure-garden or *Jardin d'agrément*, in the German or French sense, but it has its own peculiar charm. The cosy arbour which is hardly ever wanting in the most modest German house garden, in whose shade from childhood we pass so many happy hours of recreation and agreeable work, is not to be found in the Niwa.[2] There is also no fine, carefully kept sward, with flower-beds here and there, and broad gravel walks. But there is often a great deal of taste and refinement manifested in imitating nature and constructing a miniature landscape. If the limited space will not permit a little pond in which gold fish and turtles may comfortably play and lotus flowers unfold their lovely leaves and petals in midsummer, there is nevertheless room for a modest water-basin, with small red-bellied Imori (*Triton subcristatus*) in its clear bottom, for a small arched bridge over the little stream flowing from it, and a pile of rocks. On a somewhat larger plan, this becomes a beautiful cool place where clear rippling water flows from a little mossy grotto, whose arches are built up in close imitation of mountain rocks. These are covered with ferns and little bushes of Tsutsuji (*Azalea indica*, L.), resembling our Alpine roses, being clothed in early summer with red blossoms; and further, with the beautiful Daimiôjisô (*Saxifraga cortusæfolia*, S. and Z.), and other tastefully

[1] Most of these very interesting large parks, with their grand old tree-groups and tasteful landscapes of rock and water, avenues and lodges, their many sorts of fanciful gardening, pruning, dwarfing, and deforming, stone turrets and idols, were destroyed after the Restoration. The finest specimen of Japanese landscape gardening now to be seen is at Fuki-age, the Imperial Garden in Tôkio.

[2] The Glycine (*Wistaria chinensis*) is cultivated here and there on trellises, but not in order to afford shade, only to better exhibit the hanging clusters of blossoms. (See Illustration in vol. i.)

distributed favourites of the indigenous flora. A little cemented basin or trough is made just in front of this group of rocks, where the water is collected, and near by grows the Giboshi (*Funkia ovata*, Sprengel), its bluish green leaf-tufts covered in late summer with spikes of beautiful bluish white flowers.

The narrow paths which wind through a Japanese garden of this kind are paved with one row of stone slabs, in which all regularity of form is avoided. There is no attempt to make the edges even. Potted plants of the popular dwarfed varieties take the place of borders on both sides.

Japanese art-gardening is carried on with very few implements—and these few but poorly adapted to their purpose—but with great manual skill. It does not compare with European gardening in perfection of taste and execution, nor in the ways and means which are at the command of our gardeners. It must be regarded, however, as a sample of Japanese taste, just like some specimens of their art industry. Our gardeners have learned with great care the requirements of all the plant-life in their domain, and seek by fulfilling these conditions to bring all to their highest natural perfection. On the other hand, the Japanese gardener tries to keep all bushes and trees constantly pruned and trimmed, and in many other ways to obstruct their natural development; now to produce symmetrical forms, after the fashion of old French gardening, and again to prevent symmetry by fanciful creations, dwarfed and deformed figures, and to work in a way utterly incomprehensible to us. There is now-a-days a tendency in Europe to imitate this sort of gardening in its quaint artificiality; but it is not according to our taste, and only admissible in exceptional cases. Our gardeners help nature; the Japanese do her violence. But Japanese gardening is praised in many books, just for this unnatural tendency, while to us it appears like incomprehensible trifling and waste of effort.

Dwarfing or enlarging one part at the expense of the other, variegation and cultivation of every accident or trick of nature, are, as has been intimated, the careful occupation of the Japanese gardener. He distinguishes himself in these efforts, and even becomes, in one or the other, a specialist. He works with great enjoyment to himself, and knows also that he is pleasing the taste of his customers, among whom he counts not only the educated and the rich, but also the ordinary labourer.

The Japanese not only take great pleasure in this artificial deformation, but they admire and collect also natural malformations of every kind. They admire a stone, *e.g.*, through which water has worn a hole, or an old decaying tree-trunk with one or more plants growing out of a knothole where seeds have been accidentally lodged. This is due to the same intellectual laziness, and is an example of the charm which striking phenomena have for many people with us also, and which the uneducated admire everywhere, but with us the admiration is usually diverted from nature to other objects.

Dwarfing or Nanisation is the name which we give to the various operations for producing dwarfed forms, an art in which the Chinese and Japanese are masters, and which they employ more with ornamental plants than with fruit trees. Chinese girls cripple and deform their feet in tiny shoes, and the art and trade gardeners of Eastern Asia frequently check the growth of plants by forcing them into small jars, by frequent transplanting, and by scanty nourishment and close pruning. Their exertions seem directed either to reduction of size, while retaining the form, or to the production of monstrosities of different kinds.

To produce a slow growth they choose particularly small seeds from a poorly developed individual plant. Frequent cutting back has been found even more effective, also planting in pots of insufficient size. Twisting the twigs and stems in a horizontal spiral direction has the same effect, and the refrigeration of the ground and roots by evaporation, using porous pots. Grafting is often also a means to this end, *i.e.* it serves to check natural development. It is employed especially in the many varieties of Momiji (*Acer polymorphum*), and is usually effected according to the oldest methods known to gardening—grafting by juxtaposition, a sort of "greffe par approche" as it is called by the French. The cutting which is to be engrafted is sharpened on one side and laid in an incision cut diagonally in the wild tree, or attached to the wild stock by a sort of splicing, and then carefully bound.

Some of the results obtained in Chinese and Japanese gardening in dwarfing species are very surprising. Kaempfer relates that he once saw growing together in a small box, 4 inches long, 1½ inches broad, and 6 inches high, a bamboo cane, a pine tree, and a blooming Mume-plum tree. The price of this group of dwarfs was 1,200 Dutch gulden, or nearly £100: an evidence of the difficulty and tediousness of the accomplishment, also a token of the high estimation of such abnormal forms; for what nurseryman in Europe would think of asking one-tenth of this sum for this sort of production?

The employment of this peculiar art of Nanisation on some of the coniferæ is very popular, especially on the Matsu (*Pinus Massoniana* and *P. densiflora*), the Nagi (*Podocarpus Nageia*) and Koyamaki (*Sciadopitys verticillata*), also on Mume (Prunus Mume), Sakura (*P. pseudocerasus*), Kaki (*Diospyros kaki*), Momo (*Amygdalus persica*), Masaki (*Euonymus japonicus*), and several other ornamental plants, among them the bamboo cane. Particularly scarce varieties of such dwarf plants are put up in finely decorated blue porcelain pots, and bring high prices.

Whoever visits a Japanese art and trade-garden in spring will notice in company with these dwarf forms, yet another kind of popular plant-maiming, which is usually practised on the Prunus Mume. Young and blooming shoots from stumps of 30 to 100 c.m. height are wound about them, or bent over them umbrella fashion. Often the trunk is cut down even with the ground, so that the small, blooming offshoot looks like an independent tree.

Variegation.—Many readers of these pages will remember the time when beside the common ribbon grass (*Phalaris arundinacea*, L., *var. picta*) in our gardens and public parks only a few other plants were found in which the leaves departed from the normal green colour. But now-a-days there are numerous species which show the so-called variegation (appearing now in this way and now in that), in the form of white, yellow and brown spots or stripes on the green leaf-ground. No other land has furnished nearly so great a number of these varieties as Japan. This peculiar tendency of many of its ornamental plants continues even with us, and has enriched our gardens with many kinds of variegation. Siebold attributes it to the influence of the night frost, but without substantiating the opinion.[1]

Out of the great number of such Japanese plants, with striking variegation, I will name only Pines, Juniper, Retinispora, Thujopsis, Podocarpus, Eurya, Laurus, Elæagnus, Aucuba, Pittosporum, Aralia, Salisburia, Euonymus, Sciadopitys, Eulalia, Weigelia. At the Paris Universal Exhibition in 1878, the Japanese surprised us still further with variegated Eriobotrya, and Andromeda japonica.

Ornamental plants, like other fancies of amateurs, are subject to fashion. The group of variegated foliage plants unquestionably belongs to the fashionable articles of our present ornamental gardening. They should be used sparingly, however, and with taste, in landscape gardening, otherwise they become wearisome, for many of them are not at all beautiful, and cannot be considered a real addition. A few years ago, in the park at the Universal Exhibition in Antwerp, there was a bed composed entirely of bushes of the Euonymus japonicus, showing white and yellow-flecked leaves in proximity to many simple green leaves, the combined effect of which did not please people of educated taste nearly so well as a similar group having no such mottled appearance.

The arrangment and colouring of bouquets is not understood by the Japanese. The separation of flowers from their stems and gathering them in bunches is not to their taste. They admire far more their individual beauty and enjoy their natural combinations, —the lovely blossoms (Hana) and leaves (Ha) on their stalks (Koyeda) or slender twigs, the iris and the lotus flower on its long stem

[1] "C'est surtout l'influence du froid, qui a produit les variétés nombreuses des plantes panachées de blanc et de jaune. C'est la gelée, qui, n'étant pas assez forte pour détruire toute végétation des plantes sus-tropicales, change le coloris de leur feuillage et même de leurs tiges ; c'est donc la gelée qui couvre les feuilles de flocons d'une neige perpétuelle—qui produit des plantes panachées."—Sur l'état de l'horticulture au Japon, p. 2. Leide, 1863.

(Kuki). One would scarcely suppose that under such circumstances there could be such a thing as "the art of arranging flowers" in set pieces. Nevertheless Japanese literature possesses under this or similar titles a number of works full of illustrations in which, however, the many forms of Hana-ike or flower-vase play a conspicuous part, and a labouring man, obliged to content himself with a cylinder vase of bamboo cane, or an earthen vessel, can learn but little to his advantage.

The enjoyment of beautiful flowers is common to all the Japanese people. Even the humble labourer is a customer at the gardens where flowers are kept for sale. In view of this, Hana-ichi, or flower markets, are often held on summer evenings, lighted with torches of pitch and many-coloured lanterns. They attract the poorer classes especially, and afford them an opportunity to gain a flowering sprig of the most popular plants, which bloom at this time.

There is perhaps no other nation of which all classes enjoy nature, and especially her flora gifts, to such a degree. This shows itself particularly at times when this or that favourite flower is blooming in the open fields. With us, in the outskirts of our cities, the different resorts attract great numbers of people on Sunday and other festivals. But in the Japanese cities it is a much more common sight at times to see the streets full of merry men and women of all ages and ranks, dressed in holiday attire, seeking here the blooming cherry-trees on the hill, there the sword lily in the open field, and yonder a garden of chrysanthemums, or the beautiful autumn leaves of the maple and other plants.

If we consider further that this love for flowers is no new thing with the Japanese, but existed long ago, when our whole civilization was in its swaddling clothes, we can easily estimate something of the influence it has exerted from the beginning. More than a thousand years ago, the poet Mitsune, whose verse on the fragrance of the Mume is quoted on the next page, wrote as follows concerning the Fuji, or Glycine (*Wistaria chinensis*) that was blossoming on his dwelling.

> "So, wie die Woge zum Strand, so kehren die Leute stets wieder,
> Wandelnd am Hause vorbei, staunen den Fuji sie an."[1]

The number of species and sub-species of the ornamental plants of Japan is very great, but only a small selection have become especially popular. The rose is not one of these, and even the camellia, notwithstanding it is so much cultivated, does not rank among the highest. Their favourites, which are associated with their civilization, their festival seasons, their entire life, and are constantly reappearing in their art-industry as patterns, were long

[1] "Waga yado ni | sakeru fuji nami | tachi kaeri | sugigate ni nomi | hito no miruramu."—R. Lange, Old Japanese Spring-ballads. Berlin, Weidmann, 1884.

ago arranged, according to their flowering seasons, in a flower calendar, at a time when no one in our country would have thought of such a work.

In the old reckoning of time by lunar years, borrowed from the Chinese, Guwan-jitsu, or New Year's Day, occurred in the middle or at the end of February, and with it began "the lovely month," Mutzuki. The festival of the New Year consequently became a time for rejoicing over the newly awakened forces of nature, and was celebrated in many ways both without and within doors. Flora brought to the merry making the first flowers of spring in all their beauty, and Uguisu, the nightingale, in the mild evenings, made glad the pleasure gardens or temple groves with her lovely song.[1] Of plants, the white and red blossoms of the Mume (*Prunus Mume*, S. and Z.) contributed not a little to the festal mood, appearing as they do at this season, as heralds of spring in advance of the leaves. No Japanese house was without them. We greet our primrose (*Primula veris*, L.) every year afresh, and rejoice in its appearance. The Mume is in much greater degree the favourite of the Japanese people and inspires them with longing and delight. Poets praise its blossoms more even for their lovely fragrance, exhaling especially at night, than for their number and colour.

> "Schwer erkennst Du im Glanze des Mondes die Blüthe der Pflaume.
> Aber Du findest sie gleich, gehst Du dem Dufte nur nach."
>
> MITSUNE.[2]

The Uguisu, or Japanese nightingale (*Cettia cantans*, T. and Schl.), joins the poet in spring, and sings as if rejoicingly over the year's first-blown perfume, and mourning over the speedy withering. And the pictorial art of the country, more developed than its modest poetry, has bound the Mume and the nightingale, or Uguisu, together, and represented them in picture and in plastic form in the various creations of art-industry. The Mume thus devoid of leaves resembles the blooming branches of our blackthorn.

Beside the Mume, the Japanese gardener at New Year's time bring also much to the market, the Rengyo (*Forsythia suspensa*, Vahl) with branches hanging full of yellow bells. This plant has been introduced into Europe from Japan, but is as little at home there as the Mume, and the following species which, like it, have their origin in China.

The Dodan (*Enkianthus japonicus*, Hook.), which is cultivated in gardens on account of the beautiful red colour of its leaves in autumn, is also used for decorating the houses at the New Year's festival. It does not bloom in the open air till one or two months

[1] In accepting our calendar, and moving the New Year's festival into the rough weather of January, it has lost a great part of its earlier poetic charm.

[2] "Tsukiyo ni wa | sore tomo miye zu | mume no hana | ka wo tazunete zo | shiru bekari keru."—Lange, Old Japanese Spring Ballads, p. 30.

later, and must be grown in the florist's hothouse for this purpose, as in China.

In March, the second month of the old Japanese year, the flowers of the Momo, or peach tree (*Amygdalus persica*, L.) follow the Mume, and towards the end of the month those of the Higan-sakura (*Prunus subhirtella*, Miq.) are seen. Several Magnolias, too, unfold their blossoms at this time, before their leaves come forth. Prominent among them, *Magnolia conspicua*, Salisb. (*M. Yulan*, Desf.), the Hakuren, or white lotus flower of Japan, and the Kobushi (*M. Kobus*, D. C.).

April is the flowering time of the second great favourite of the year—the Sakura (*Prunus pseudocerasus*, Lindl.). This is called the Japanese cherry-tree, because its whole appearance and flower resemble the cherry; but its fruit is not pleasant to the taste, and not larger than that of our Prunus Padus (see also p. 249). The wild original variety, which grows extensively in the mountain forests, is called Yama-sakura. A great number of varieties, with pink and white blossoms, have been developed from this tree, among which those with very full flowers are especially noticeable.

The Sakura is sung by Japanese poets almost as much as the Mume, and copied likewise in art-industry. For this, the simple flower of the Yama-sakura is always chosen, and may be easily recognised in decorations by the accompanying leaves.

The soft air of the south-western monsoon prevails at the flowering time of the Sakura. Nature is then at her best, and invites again into the open air. It is an old custom and pleasure of the most innocent sort, to wander forth at this time by families, and admire the Sakura—a pleasure in which everybody shares. It is a delight even for the stranger to see so many happy, gaily dressed people. He, too, follows with the crowd toward Mukô-jima, Uyeno, Ôji, and different other places in and around Tôkio where the Sakura grows in greatest quantities. The Sakura of Yoshino in Yamato has also an old reputation. So by Tomonori more than a thousand years ago, of whom a couplet runs this way:

> "Wenn ich auf Yoshino's Berg die Blüthe der Kirsche erblicke,
> Täuscht mich ein lieblicher Trug, denn sie erscheinen wie Schnee."[1]

A kindred species appears here and there in gardens about the end of May—the Niwa-sakura (Garden Sakura), or Kó-sakura (Little Sakura), also in full bloom. It is the Japanese dwarf cherry-tree (*Prunus japonica*, Thunb.), resembling Amygdalus nana in its bushy appearance.

The Yamabuki (*Kerria japonica*, D.C.) has earlier, and at the same time as the Sakura, unfolded its yellow blooms. The wild bush is very frequent in the mountain forests and on the river

[1] "Miyoshino no | yamabe ni sakeru sakurabana | yuki ka to nomi zo | aya-metari keru."—Lange, Old Japanese Spring Ballads. Berlin, 1884.

banks of Middle and Northern Japan, but much more rare in the South. The double variety was imported into Europe during the last century, while the single form has come to us only recently.

In May, the magnificent blossoms of the Botan (*Pæonia Moutan*, Sims.) appear; also those of the Fuji (*Wistaria chinensis*, S. and Z.), the Kiri (*Paulownia imperialis*, S. and Z.) and the Tsutsuji (*Azalea indica*, L.). The last of these four ornamental plants is the most extensively cultivated and popular. The red-blossomed variety predominates, especially in a wild state. In the spring, in company with Deutzia, it adorns not merely the uncultivated sunny slopes all through Japan, and likewise China, but is found in almost every garden. It blooms in April, on Kiushiu (and is used very much for decorating graves, its blossoming branches being placed in bamboo vases); in Middle Hondo, in May; and still farther north, and higher up in the mountains, not till June. A large number of kindred species, among them some of great fragrance, must be reckoned with them, some of which have been transplanted into gardens. Among these are the *Rhododendron* (Azalea) *macrostemon*, Maxim., *R. ledifolium*, Don., *R. sublanceolatum*, Miq., *R. macrosepalum*, Maxim., *R. sinense*, Sweet, and several others.

The noble blossoms of several kinds of Iris delight the lovers of flowers in June—particularly the Hana-shôbu (*Iris lævigata*, Fisch.) and Ayame (*Iris setosa*, Pall. and *I. sibricia*, L.). A speciality is made of their cultivation in several places in the neighbourhood of Tôkio. There are low-lying open fields, *e.g.*, near Meguro, and especially on the left bank of the Sumida-gawa at Hori-kiri, which, toward the end of the month, are all a-bloom with them; and many who delight in flowers, who wandered out to Mukôjima, in April, to enjoy the blossoming Sakura, now pass on by the long avenue of these trees to Hori-kiri to admire the flowering Shôbu (Hana-shobu). When this season is over, and the summer heat has reached its greatest height, in July, then comes another, and more esteemed favourite, the lotus-flower, Hasu-no-hana, or Renge (*Nelumbo nucifera*, Gaertn.).[1] Mention has already been made of the edible, long-branched roots and nut-like seeds of this the most interesting and splendid of water plants. It only remains to note its significance in the worship of Buddha, and as an ornamental plant. Its original home was without doubt the Indian monsoon district, and its cultivation and estimation very ancient. It was formerly, together with the fishes and turtles in sacred tanks, dedicated to Çiva, who, according to an old Indian legend, sat upon its leaves looking on when the great flood swallowed up everything. Buddhism took it later as the symbol of its teachings. As it lifts up its buds out of the slimy ground to a greater or less height above the water, unfolding its beautiful leaves and flowers, on whose spotless petals no traces are to be found of the mire from which it has

[1] The plant is called Hasu; its rhizoma, Renkon; the seed, Hasu-no-mi; the leaf, Hasu-no-ha; and the swamp or pond in which it grows, Hasu-no-ike.

sprung, so the souls of men, according to Buddhist faith, rise from the slime of sin, by their own power and effort, to different heights, and reach the blessedness of Nirvana. Buddha is represented sitting on an open lotus flower, the emblem of purity, and his temples and altars are adorned with vases and imitations of blossoming lotus plants in bronze, wood or clay. In view of these facts, we may accept the belief that the distribution of this honoured plant in the countries of Chinese culture in Eastern Asia also followed close upon the spread of Buddhism.

I do not yet know for a certainty whether the Egyptian lotus, mentioned by several classic writers of ancient times, is the same as ours, or a nearly related plant. Its seeds, the Pythagoras or Egyptian beans (*Fabæ ægyptiacæ*, Plin.), were eaten, like those of the Indian lotus in monsoon lands. Theophrast compares its fruit (Torus) very aptly to a round wasp's-nest, and Herodotus to a large poppy head, but the description of its roots by the latter does not at all fit the rhizoma of the holy lotus of Asia.

Sir Joseph Banks brought the first seeds of the latter from India into England in 1787. They were called "Sacred Indian Beans." Since then the plant has been cultivated in warm aquariums in nearly all European countries and in their Botanical Gardens, occasionally in open ponds in Mediterranean regions, and at midsummer reaches its highest perfection. In Eastern Asia the predominating most widely cultivated species has pink blossoms, but in Japan and China there is another variety, whose flowers of purest white are no less beautiful.[1]

According to Fortune, a great number of these water-lilies grow on the banks of the river above and below Canton, which are kept in dams like the rice-fields. He writes: "This plant is cultivated partly for decorative purposes, partly for its roots, which are brought to market in great numbers and are much liked by the Chinese." It is the same in Japan, as before noted.

In midsummer the water-surfaces of old moats and ponds in Tôkio are adorned with numberless leaves and flowers of the lotus plant. While nearly all the other Nymphæaceæ spread out their dull green leaves flat on the surface of the water, the lotus lifts hers, as she does her flowers, on long stems high above it. A beautiful green colour, fine veining and shell-like arching and cavity distinguishes the leaves also, and they are scarcely less beautiful when the dewdrops lie upon them in the morning like thousands of pearls, than when these are chased away by the beams of the rising sun. But now the countless buds and tulip-like flowers unfold. Unfortunately, the plant is an ornament of standing waters only during the summer and autumn months, and not

[1] Haku-ren,—"white lotus flower,"—as remarked above, is also the designation of the blossom of the *Magnolia Yulan*, Desf., and there is indeed great similarity between the two.

through the long winter, when their dead withered leaves offend the sight.

In August and September, the flowering season of the lotus is followed by that of the so-called "Seven Autumn-plants" (Aki-nona-na-kusa). These are Hagi (varieties of Lespedeza and Desmodium), Fuyô (*Hibiscus mutabilis*, L.), Omina-meshi (*Patrinia scabiosæfolia*, Link.), Fuji-bakama (*Eupatorium chinense*, L., and *E. japonicum*, Thunb.), Kikiyô (*Platycodon grandiflorum*, D. C.), the two grasses Susuki (*Eulalia japonica*, Trim.) and Kara-kaya (*Anthistiria arguens*, Wild.). All, except the Hibiscus, adorn the flower-meadows, or Kusa-wara, in midsummer and autumn. Hagi, particularly *Lespedeza cyrtobotrya* and *Desmodium penduliflorum*, Oud., with their leaves resembling Citysus, and their violet blossoms, also Fuyô, Ominameshi and Susuki are very popular as decorative designs in art-industry. The Tamano-o (*Sedum Sieboldi*, Sweet) blossoms as a pot plant in Japan, as with us, in September and October.

While the blooming Mume beautifies the New Year's spring festival, the first of the five great feasts of the year, the Kiku-no-hana, or chrysanthemum flower, is dedicated to the last of these secular festivals, which occurs on the 9th day of the 9th month old reckoning, or toward the end of October, in the new. This Kiku-no-sekku, or Chrysanthemum festival, draws the joyous, happy crowds to the flower-markets and into the large gardens which are celebrated for the cultivation of *Chrysanthemum* (Pyrethrum) *indicum*, L., *Ch. sinense*, Sabin, and kindred species. Kiku (Chrysanthemum) rich in variety and colour, the favourite of all the autumn Flora of Japan and China, is hardy and easy to cultivate. The flowers of the different varieties are as numerous and manifold in colour, size and form, as are asters with us, and are of very ancient cultivation. Many gardeners make a specialty of them and become widely known thereby. The Kiku beds of Sugamo on the Nakasendô, for instance, attract many admirers in the early part of November. Kiku-no-hana is as much liked in art as in nature, and has no rival as a pattern in the decoration of pottery.

The arms of the kingdom, called Kiku-no-hana-mon (see vol. i.) consist of an outspread, wheel-like chrysanthemum of 16 petals radiating from a small central circle, and at the outer edge are bound together by 16 little arches. It is an emblem of the sun and is the imperial insignia on cockades, banners, documents and coins. In 1784 a number of varieties of the Kiku were brought to Europe from India and China, but they have not yet driven the asters and other popular autumn flowers from the field.

Toward the end of October and beginning of November, when the rough monsoon of winter blows from the north and the landscape has taken on quite another character in the field and wood, the Japanese lover of nature makes his last holiday excursion, to see the Momiji (*Acer polymorphum*, S. and Z.). The maples most extolled and sung are those of the Tatsuta-gawa, the Tatsuta-momiji at Tatsuta in Yamato. The Momiji in their motley or simple red autumn colours are also favourite subjects for representation with Japanese artists. Besides them, the Dôdan (*Enkianthus japonicus*, Hooker), the Azaleas and other garden plants are noted for the beautiful colouring of their leaves before they fall. The autumn dress of the foliaceous forest is much more varied and rich in colour than even that of the Atlantic forests of North America, so much praised (see vol. i. p. 137). When this has disappeared and the winter rest has begun, the Japanese flower-calendar still points to a limited number of fine ornamental plants which for the most part have been domesticated in Europe also, and are much more valued here than in their East-Asiatic home. These are chiefly Yatsu-de (*Aralia japonica*, Thunb.), Hiragi (*Olea aquifolium*, Thunb.), and Sasan-kuwa (*Camellia sasanqua*, Thunb.) which like the tea bush bloom in November and December, and Tsubaki (*Camellia japonica*, L.) which, as an out-of-door plant, shows its first flowers in January.

Foliaceous trees are only exceptionally found as umbrageous trees in the Japanese cities, as at Niigata, and never on the country roads. In many places these roads are beautified with evergreen Coniferæ which are often several centuries old and make a grand impression. Euonymus radicans or some wild vine, or more rarely the ivy, climbs up and covers their powerful trunks. The finest of these trees is the Sugi or Cryptomeria, which appears here and there, principally around Nikko. The great Sugi-avenue, of which a phototype is given vol. i. p. 150, is the most celebrated and unique of kind. Retinispora too, especially Hi-no-ki trees, are in some places put to this use.

The Matsu, or pine, (*Pinus Massoniana* and *P. densiflora*), is the most frequent and most popular umbrageous tree on the Japanese roads. The hand of the gardener in this case has not changed its figure. This great tree, the favourite of the Japanese people, appears here in its most picturesque forms, primitive and bizarre; with trunks straight and bent; with branches often twisted in every direction, knotty and extended, and covered with a close mass of dark green needles. There is no symmetry, but the eye is pleased, and rests with satisfaction upon these primeval, powerful and picturesque figures—these silent witnesses of a long past time. How many storms they have defied—how many designs for the beautifying of nunberless specimens of art industry they have furnished—how many eyes and hearts they have rejoiced! This is the tree which, bold and strong, speaks most surely of the preference of the people for odd, irregular form; but on the other hand, when it appears singly in the garden and temple grove, it is more than all others the subject of the gardener's moods and tricks. Here it has been forced into all possible dwarfed and abnormal shapes, which excite not a little astonishment at what seems to us, the incomprehensible taste which finds pleasure in such unnatural forms.

8. Acclimatization and Extension of Japanese Ornamental and Useful Plants in Europe.

The acclimatization of a plant is its adaptation to the climate and soil of a strange locality. It is evident that its naturalization will be the easier the more closely the new dwelling-place conforms in both these particulars to the old ; and, on the other hand, that it must be difficult in most cases, if not impossible, wherever these are widely divergent. For the inner structure of the plant, and its whole development, depend most intimately on the conditions of its nourishment by climate and soil.

Summer growths, and all perennial plants which are propagated from seeds, can never be naturalized where the seed-germ does not reach its full ripeness. Others are not acclimatisable where, from time to time during the winter they freeze, however favourable their summer development may be. The winter of 1879–80, for instance, in France and Germany, destroyed a great number of California Conifers, which for several decades had been growing most successfully, and showed plainly that their complete naturalization is impossible with us. Trees, however, which are propagated from their roots, will grow where they cannot ripen their seeds, and indeed where they partly freeze in severe winters. The upper perishable part of the common broom was killed by the cold in many parts of Germany in December, 1879, but in the following summer the sound roots made a complete reparation, and this has been true also with Kerria japonica. Another Japanese plant, Paulownia imperialis, thrives well in England, but rarely produces flowers, and never seeds capable of germinating. It is easily propagated however from the roots, as is the case with the large bamboo cane of Japan, and may be naturalized to a limited extent.

It is very important that the conditions under which a plant grows and thrives in its home be well understood before making attempts to cultivate it elsewhere. Often this rule is not observed, and one learns, by many useless efforts and dear experience, what might have been obtained by a much shorter and cheaper way. The story of the introduction of Aucuba, and many other popular Japanese ornamental plants, furnishes many instructive suggestions.

On the other hand, experience shows too that many plants have a very extensible habitat, *i.e.* are less dainty in respect to their demands upon climate and soil, while others are very choice in these respects. Only a trial can decide how far a plant will accommodate itself to its environment. Of two, which have the same home, growing near each other on the same ground, and under the same climatic influences, one will easily domesticate itself on a foreign soil, the other not at all. As I have already remarked on page 160, in connection with the lacquer tree, this plant proved quite hardy enough to endure winters in Germany. But in Japan it is found in the neighbourhood of, and cultivated side by side with the camellia, Olea aquifolium, and other ornamental plants which are there sometimes exposed to night frosts reaching $-12°$ C., but in Europe will not live out of doors north of the Alps.

As the Camphor-laurel is indigenous to a country having much summer rain, and in winter undergoes night frosts in which the mercury in the thermometer occasionally sinks to $-9°$ C., its thriving condition on the North Italian lakes and the Riviera is easily comprehended. That it does well also in the hot, dry, atmosphere of Egypt and the Canaries, shows its power of adaptation in a direction in which not many Japanese plants can follow it.

The grape vine thrives to a certain extent in many different climates and soils, but how largely is the character of its fruit changed thereby! To take still another example, the varied conditions of the poppy (*papaver somniferum*), whose capsules contain with us only traces of the well-known opium alkaloids, while in warm countries, like Asia Minor, Egypt, and India, it is cultivated solely for its opium, which varies significantly in its chemical composition according to the land which produces it.

From these few examples, to which many more might be added, it is satisfactorily shown that the ability of a plant to adapt itself is much greater than its full acclimatization, if we understand by the former the thriving in changed climate and soil without degeneration, *i.e.*, without essentially altering its original character.

Annuals acclimatise themselves easier than perennial plants. This is an old experience and easy of comprehension. A number of well known weeds have become scattered over a large part of the earth with our garden and field fruits. They spread luxuriantly in climates vastly different from ours, as do many of our grains and vegetables, for the main thing with them is, next to a certain degree of moisture, the presence of sufficient warmth to ripen their seeds.

With wood growths the matter is more complicated. Their perfect acclimatization depends on both of the principal seasons of the year, and much more on the extreme than the middle temperatures. They must at least prove themselves hardy against the winter's cold. Their power to withstand unusual cold is conditioned, partly on the full ripening of their wood in autumn, and that vegetation shall not at this season receive a fresh impulse from unusual heat. For when this happens, a new circulation of the sap begins, the preparation for winter is lost, and the plant consequently can endure but little. It finds itself then in the condition of a animal in northern regions without its winter coat. Therefore one cannot condemn a plant as not adapted to cultivation because it succumbs to unusual cold, coupled with other unfavourable preliminary conditions. No one will maintain that rape or clover are not suited to our climate, because they at times fail in the rigour of our winter, or that the olive tree is not really acclimatized in Spain, because some years ago an unusual November frost created considerable desolation in the olive groves of Andalusia.

No other land, the United States of North America hardly excepted, has furnished us so large a number of fine ornamental plants as Japan. Our landscape gardening has gained much from their introduction, which has taken place mostly within a hundred, indeed during the last fifty, years. Blooming Camellias, Azaleas, Forsythia, Kerria, Spiræa, apple and plum varieties, belong to the first spring adornments of our flower stands and gardens. Beautiful foliage plants, like Azalea, Aucuba, and Sedum Sieboldi, and several Conifers decorate them the year through, and it is scarcely possible to specify the great number of Japanese plants which delight us during the summer by their lovely flowers. I note only the Pæony, Wistaria, and Paulownia, the several species of Weigelia, Clematis, Hydrangea, Philadelphus, Deutzia, and Spiræa, the Lilies, Panther Lilies, and Funkia. What abundance and beauty of blossoms they develop—how many gardens and parks they adorn! And when we cross the Alps and in the lovely gardens and parks of the Mediterranean review their chief ornaments, we find the very same, and among them a number of other Japanese immigrants for whom our winter is too severe, while there they thrive at their best, and contribute materially to the peculiar and attractive plant cultivation.

The evergreen trees and bushes from Japan—I refer now only to Eriobotrya, Cinnamomum camphora, Euonymus, Ligustrum, and the many Conifers—proved themselves better able to resist the severe winter of 1879–80 in Northern Italy and Southern France, than many of the oldest indigenous growths, *e.g.* ibex, olive, myrtle and orange. It is no wonder that their cultivation becomes constantly more extended.

It is not possible sharply to distinguish the ornamental plants originating in Japan from those of China. This is not only because the Flora of both countries show so many common varieties, and this near relationship of taste is seen more noticeably in cultivated plants, but because the same variety is often introduced into gardening not only from Japan, but also from China.

It is often difficult, and even impossible in many cases, to find out the time and manner of the importation of at least 300 varieties, still there are accounts enough (I refer only to those in "Ait. Hortus Kewensis") to make it certain that during the Portuguese trade with Eastern Asia, not one of the ornamental plants of that land was naturalized in Europe. Not a single specimen from China or Japan is known to have been cultivated in Europe before the eighteenth century, and of but very few—Camellia japonica, Cinnamomum camphora, Hibiscus manihot, Dianthus japonicus, and Elæagnus latifolia—that their culture began before 1750.

From this time the importation of new varieties increased. For example, Chrysanthemum indicum and Gardenia florida were introduced into England in 1754, and during the same year the first two out-of-door trees were imported, which have found such a wide extension in Europe, viz., Sophora japonica, and Salisburia adianthifolia.

During the last two decades of the last century, Sir Joseph Banks, the friend of Solander, and with him the companion of Cook on his first voyage round the world, ranked next to Thunberg in his exertions for the introduction of Eastern Asiatic plants. He brought first into Europe, among others, A. Pæonia Moutan, Nelumbium speciosum, Pyrus Japonica, Eriobotrya japonica, Hydrangea hortensis, Diospyros Kaki, and Rhus semialata. In this century, P. von Siebold, Fortune, and Veitch are prominent in the introduction of Chinese and Japanese ornamental plants. They brought chiefly Japanese varieties of pot plants with variegated leaves to the Netherlands or to England. And Maximowicz, the thorough investigator and connoisseur of the rich plant-world of Japan and of Eastern Asia in general, successfully exerted himself to import several ornamental Japanese plants into Europe. I refer only to several fine Rhododendron (Azalea) varieties which were brought by him to St. Petersburg, and from there spread towards the west.

Instead of enumerating the long list of Japanese ornamental plants, which would be without meaning to the novice, and superfluous to connoisseurs, I will limit myself to a few widely spread and popular species, giving several facts concerning them which may be of interest to lovers of flowers. I begin the with plant which stands first, not only in the order of popularity, but also of the time of introduction ; viz. *Camellia japonica*, L., the Tsubaki of the Japanese. The considerable size which this shrub attains in Japan, the use and value of its wood, and the oil prepared from its nuts, have been previously mentioned. The wild variety belonging to the forest is called Yama-tsubaki. Its simple red flowers open only in a bell, and not a wheel, form. Kaempfer, Thunberg, and Siebold go too far, when they maintain that Yama-tsubaki is spread over the whole of Japan and forms dense forests.

As mentioned in vol. i. p. 164, this camellia grows in southern Japan to a tree of considerable size, 10 m. high, and 1½ m. in circumference, and in the mountain forests of Kiushiu and Shikoku, under favourable circumstances, up to 1,000 m. above sea level, so that here it exceeds the lower limits of the beech. I found once in April, to my surprise, in the neighhourhood of Sasagami-tôge in Shikoku a large camellia tree 900 m. above the sea level, whose blossoms had fallen and lay on the ground with beech leaves and blooming Asperula odorata. Farther north and more removed from the influences of the Kuro-shiwo, this high limit of the wild growing camellia falls rapidly, and its dimensions decrease also.

It becomes a mere bush such as we find it in our plant-houses. Chôshi-no-kuchi on the Pacific coast and at the mouth of the Tonegawa, near the 36th parallel, is the northern limit of Yama-tsubaki. Still I have found it in Western Hondo near the Japan Sea, a little lower than the 38th parallel, and in the hill forests of Northern Echigo, where it forms an under-brush about a meter in height.[1]

The camellia, cultivated for its oil or for ornamental purposes, appears as an out-of-door plant around Hakodate, in Northern Hondo, generally in tree form with single red flowers like the wild varieties, or it is a bush in a number of species, part of which have single and part double flowers, but not in such a large number of varieties as our hothouses show.

Since very ancient times the camellia has been prized and cultivated in China as a decorative plant. It is not known when and from what point it was brought to the island of Luzon. The Moravian Jesuit, George J. Kamel (Camellus), who visited Manila in the 17th century, and later published a "Historia Stirpium Insulæ Luzonis," first mentioned the plant in this book. It was in 1737 named in his honour by Linnæus in his work "Genera plantarum." The earliest picture of the camellia appeared in 1702 in Petiver's "Gasophylacium."[2]

In 1739 the camellia was transplanted from Manila to the Jardin del Buen Retiro at Madrid. At that time, however, the single red-blossomed variety had already been introduced in England by Robert James Lord Petre, and was known as the Japanese rose.

Lagerström, director of the Swedish East India Company, brought the first two varieties to Upsala in 1745, but still Tsubaki was a rarity in Europe up to one hundred years ago. Most of the numerous varieties have been brought from China and Japan during this present century, or gradually formed by our nurserymen.

In the cold houses and forcing houses of the temperate and colder countries of Europe, where the conditions of its growth are well understood and followed, the number of varieties of the camellia is much greater, as has been said before, than in Eastern Asia.[3]

[1] It may perhaps interest some readers acquainted with Japan, to learn more about this growth. It is on the way from Gatsuke on the Japan Sea, to Nakamura, lying inland 2 ri. 25 chô. The environs are distinguished by a large number of lacquer-tree plantations. The numerous camellia bushes, many of which had beautifully formed buds in the early part of November, with their dark-green leaves, contrast well against the bare trees and bushes which are scattered among them.

[2] See Seemann; "Synopsis of the Genera Camellia and Thea." Transact. Linn. Society, xxii. p. 342.

[3] Such camellia bloom as the Palm garden at Frankfort, for instance, offers its visitors in spring, cannot be found in Japan.

The peculiar climate of the Mediterranean district, with its long, dry summer heat, is not favourable to the camellia. It is really easier and cheaper to bring their flowers to perfection in St. Petersburg or Berlin, than in Seville, for instance, in whose hot and dry summer it never develops into a tree, but grows only 2 to 3 m. high. It does not thrive in Lisbon either, but grows well in the moister air of Cintra. Here, low camellia bushes in full bloom may be seen in March and April by some cool brook-side in the beautiful parks of Montserrat and of Penha, also in Malaga. But the bushes must be shaded during the summer and kept as cool as possible.

In Florence, the camellia needs a certain protection from the cold, as roses with us. But in and around Constantinople, where fifteen years ago it was planted in open spaces, it proved itself quite capable of resisting the severe winter of 1879–80. At the same time in Naples, outdoor plants such as the Pelargonium, Myrtle, Oleander and many other indigenous or long ago naturalized species, perished, but not the camellia.

The Riviera, and the shores of the Northern Italian Lakes offer unquestionably more favourable conditions to the camellia and a large number of other Japanese plants, *e.g.* the Camphor-laurel and most Japanese Conifers, than any other part of Europe. The Tsubaki thrives here without protection almost as well as in its Japanese home. At the Villa Charlotte for instance, there are trees of 8 m. height and 18 cm. circumference. It blossoms here, as at home, sometimes in mid-winter, but in greatest abundance during the spring months, and here too, later on, its fruits ripen in perfection.

Pyrus japonica, Thunb., Jap. Boke and Yama-boke. This genuine Japanese quince-bush grows 2 to 3 m. high and is one of the first and greatest ornaments of our gardens. In its wealth of blossoms it is more beautiful and lasting than Forsythia, as well as much more hardy and wide-spread. The large fire-red blossoms appear before or with the leaves, and cover the naked branches. Besides this original kind which blossoms in the woods and parks of Japan, as well as here, in April, (a month earlier in the south, later in the mountains), we have several varieties with light-coloured flowers, which are not as beautiful, however, as the former. The bush is easily cultivated when its stands alone and can develop symmetrically. It was introduced into England by Sir Joseph Banks in 1796, and has thence extended very widely. It is not found so frequently on the other side of the Alps and Pyrenees, although it flourishes in the south. In some of the park-like gardens of Malaga it blossoms as abundantly and as beautifully as with us, toward the end of March, and around Tôkio a month later.

Wistaria chinensis, S. and Z. (*Glycine chinensis*, Sims), Jap. Fuji. The flowering of the fruit trees is scarcely over in spring before the beautiful blue clusters of the Glycine appear. They blossom about the middle of May, at the same time with the Syringa, horse-chestnut, and bush pæony. In the mild districts of Germany, near the Rhine and Main, the Wistaria endures the winter excellently in the open air. It is trained on houses and arbours and is noted everywhere for rapid growth and the strong inclination to turn its slender branches from left to right. Several strong shoots are often wound together in a evenly twisted cable that becomes impossible to unloose as it grows larger. The Wistaria adapts itself well in Mediterranean countries, where it often creeps over the trunks of other ornamental plants, such as Shinus molle. And when its young bright-green leaves mingle with the dark-green foliage of its supports, and the abundant flower clusters hang from the crown of the latter in March and April, the sight is peculiar and often very beautiful. With us this plant blossoms often for the second time in late summer, but less abundantly than in spring.

The Latin name indicates that the Glycine had its origin in China. It is an old and very popular plant in Japan, however, as has been said before, but grows wild also very extensively in the deciduous forests of the mountains. In order to display its long cylindrical flower clusters to better advantage in Japan, it is trained horizontally along arbours. As has been remarked on p. 226, some ten years since there was a specimen at Nakanobu in the vicinity of Tôkio which was said to be 250 years old. Its low powerful and rugged trunk measured 2·45 m. in circumference before branching. The branches reached out 2½ m. over a large court, and when the many hundreds of long, drooping flower clusters appeared, it drew many spectators from the capital.

A specimen of Wistaria planted in 1845 against a house-wall in Versailles, shows the rapid growth of the plant in Europe. According to the *Révue Horticole* of 1878, it had then, after 33 years, reached a circumference of 1·20 m. and formed branches 75 m. long. Wittmack[1] mentions another Glycine at the Villa Giula on Lake Como, which had a trunk-diameter of 35 cm. (circumference 1·10 m.), and covered with its branches a wall-surface of 40 m. length to the top of the house.

Paulownia imperialis, S. and Z. (*P. tomentosa*, Ascherson), Jap. Kiri. This notable tree, which is cultivated so largely (see p. 245) and so greatly prized in Japan on account of its light wood, is also found very frequently in gardens and public parks in the warm parts of Europe. Its large fragrant blue flowers appear in May before the leaves, and resemble in form those of the "lion's mouth." One of its peculiarities is that toward the end of summer it forms the flower buds of the next season on the end of its branches. In England, these buds die during the winter, and the flowers are

[1] Wittmack; "Die Gärten Oberitaliens." Berlin, 1883.

therefore few in number. It is often the case in Germany also, as for example after the mild winter of 1883–84, scarcely any blossoms came to perfection.

The large heart-shaped leaves resemble those of the kindred Catalpa varieties, are large and darker green, however, and appear earlier. When propagated by shoots from the root, the growth is surprising, and the leaves attain enormous size. In the summer of of 1885, such a shoot, near the railway station at Godesberg, near Bonn, measured 2·8 m. in height and 17·5 cm. in circumference. Single leaves on stems 42 cm. long and 8 cm. in circumference were 80 to 90 cm. long and over 60 cm. broad. But, notwithstanding its surprising growth, the Paulownia has no great popularity with us. The tree is too bare at the flowering season, and it sheds its branches too easily to preserve a pleasing symmetrical form. It happens, therefore, that only the old specimens are generally found whose trunks have a circumference of about 2 m. After the tree was introduced into France, in 1834, many of them were soon taken thence into other countries. The Paulownia was formerly cultivated on some of the Paris boulevards, but has been removed. It is frequent as an umbrageous tree in Florence, *e.g.*, on the road to Fiesole, where, toward the end of April, the air is filled with the fragrance of its blossoms. Large Paulownia and Eucalyptus trees are most prominent of all in the public park in the neighbourhood of the railway station at Cordova. But here, as elsewhere in Mediterranean regions, one has the impression that the energy with which Kiri was cultivated 40 or 50 years ago is a thing of the past.

Pæonia Moutan, Sims, Jap. Botan, is found in many varieties, most of them introduced by Fortune, *P. albiflora*, Pall., Jap. Shakuyaku, less frequently. It is not the rose, but Botan, and the kindred Shakuyaku, which is praised by the poets in Chinese literature as the queen of flowers. It is spoken of also in the "Memoires des Chinois," Paris, 1877, as the pride and glory of China. And correspondingly it is one of the most popular modes for decoration in Chinese and Japanese art industry. The great healing power ascribed for ages to its roots (see p. 136), together with its beautiful leaves and flowers, may have contributed to its high esteem. Both varieties of pæony, known in our gardens by the common designation, *P. arborea*, Don., are classed with the most beautiful spring flowers. Fragrance is denied them, however, as it is to all the other pæonies. Their first introduction from China into England was in 1789, and is attributed, as I have already mentioned, to Sir Joseph Banks. He brought to Europe, the year before, also,—

Hydrangea hortensis, Smith (*Hortensia opuloides*, Lamk.), Jap. Ajisai. Few of the older importations from Eastern Asia have been more quickly and widely extended than this Hortensia. We have a great many varieties, whose original, simple forms are found in the forests of China, and more frequently in those of Japan. In

Germany it is known as a pot-plant generally, as it needs protection from our severe winter weather. It thrives well in the ground south of the Alps, and without any special cultivation. Besides its many varieties, we have also lately cultivated—

Hydrangea paniculata, Sieb., a tall bush known among the Japanese by the names Shiro-utsugi and Nori-no-ki, which with us is quite proof against the winter. At home it grows in the mountain forests to an elevation of 1,500 m., and is gathered for its mucilaginous inner bark, which is used in making paper. Its flowering season is in midsummer, like that of Hortensia.

Macleya cordata, R. Brown, Jap. Chanpagiku and Takeni-gusa. This perennial, herbaceous, ornamental plant from China and Japan, attracts attention by its figure and the form and colour of its leaves. It belongs to the Papaveraceæ family, is cultivated in gardens and parks from the Mediterranean to England, and lately often seen in Germany also. The perennial roots send out each year a stiff stalk, up to 2 m. in height, which, late in summer, bears on its very end a long flower-spike. The deeply indented leaves and the white down which covers the entire plant are its most noteworthy features. There are few herbaceous plants which are so majestic and ornamental in appearance.

Polygonum cuspidatum, Sieb., Jap. Itadori. This species is noted, even more than the preceding, for its exceptionally rapid and fine development. Many dozens of strong stalks shoot up, like asparagus, 2 to 3 m. high, early in the spring, from a perennial root having a pad-like appearance and thick, branching rootlets. With their fine foliage they form a close, tall bush of fine effect, especially when standing alone and developing freely on all sides.

The plant in Japan belongs to the mountain forests and the far north, so that its easy cultivation with us is quite certain.

Aucuba japonica, Thunb., Jap. Ao-ki.[1] This well-known ornamental bush fulfils nearly every condition of a good foliage plant. It is moderately hardy, and combines with this quality rapid growth, thick branches, and an abundance of large, shiny, evergreen leaves. The female tree, in summer, in addition to this beautiful and abundant foliage, bears fine scarlet berries which resemble the larger and kindred cornel cherries, but do not find a use, like them. The brownish diœcious blossoms, whose panicles appear in May on the ends of the twigs, are not at all conspicuous.

Besides the camellia, there is scarcely another of the numerous Japanese ornamental plants so popular and so widely spread as the Aucuba. Nature, accident, and cultivation have given it in its own home, and even with us, a number of sub-species which are

[1] It takes its Japanese name, Ao-ki, "green tree," from the green colour of the branches. Aucuba may be a corruption of Ao-ba, or "green leaf," or Ao-ki-ba, *i.e.* "green-tree leave," but is not used in Japan. The plant is always bush-like in its own home, so that Thunberg's designation of "Arbor magna" is decidedly erroneous.

distinguished chiefly by the size, form, and variegation of their leaves.

Japan and China are the home of the original single species. It is found in those countries with the variegated variety also as a bush 1 to 2 m. high, quite frequently, especially in the bushy forests of hilly parts of the country, also cultivated in temple groves and gardens. The story of its introduction into Western lands is not without interest. Thunberg's first description of the plant appeared in 1784. A year before, John Graeffer had brought to England[1] a female specimen with variegated leaves (*Aucuba japonica, var. punctata*) (unequal yellowish white spots scattered over the yellowish green of the leaf's surface). From this plant have sprung nearly all the innumerable bushes which are now to be found in Europe and North America, either in the open air or as ornamental plants in the house. They are propagated everywhere, and very easily by means of slips. At first the Aucuba was cared for very tenderly in hothouses, as in France; but it was found that the plant was better adapted to the cold house, and finally it was ventured out of doors. The moist atmosphere of England, with its mild winters and cool, damp summers, is most favourable to its growth. It is more frequent in London than any other evergreen, even in the humblest gardens, and one may find finer specimens of it there than even in Japan. In the Netherlands, also, and France, and in the warmer portions of Germany, especially at Bonn and thereabouts, Aucuba plays an important part as an evergreen out-of-door plant, and is seen much oftener than the cherry laurel, the Ilex, and others. It freezes in other parts of Germany in winter, and although, as a rule, it starts up again from the roots, cannot be well cultivated out of doors. The dry, hot summers of Southern Europe are also unfavourable. In Northern Italy and the South of France it is seen extensively, but farther south it falls off rapidly, and is at last only found where it can be specially protected, and in shady places.

For more than a hundred years this female Aucuba has been cultivated in its many varieties with variegated leaves. But grown either in the changeable air of the house, or out of doors in the greatest variety of soil and treatment, it has not materially altered its original variegated form, nor in one leaf even, to say nothing of its entire individuality, returned to its former simple green colouring. Can this variegation, so constant in appearance, be simply a disease?

Up to 1862, only this female Aucuba (plant veuve, as it is called by Siebold) was known in Europe. At that time Fortune found the male plant in China, also the single green-leaved original, and sent both to England. Siebold also, at that time, made the Dutch gardeners acquainted with the original plant from

[1] Aiton: "Hortus Kewensis," V. p. 257.

Japan. This is the reason why the number of single green-leaved and male specimens is so much smaller than those of the female, variegated plants. Later, a new species, *Aucuba himalaica*, Hooker, has been introduced as a decorative plant, which, however. has not begun to contest the field with the older varieties.

Fatsia japonica, Decn. and Planch. (*Aralia japonica*, Thunb., *A. Sieboldi*, Hort.). The Japanese call this plant Yatsu-de, *i.e.*, Eight Fingers—a name which comes from the eight lobes at the end of the great shiny green leaves. Many of them, especially with us, are only seven-lobed, though sometimes having nine lobes. The name Fatsia may perhaps be corrupted from the Japanese designation. This beautiful ornamental plant, of luxuriant tropical appearance, after its introduction into Europe, passed, like the Aucuba, from the hot-house to the cold-house and the flower-stand, and contests with it for the supremacy in popular taste and in ease of cultivation. It is found wild here and there in Southern and Middle Japan, but more often as a decorative plant in court-yards, gardens, and temple groves. There it blossoms, as with us, in November and December, and ripens its black berries in March.

It is much cultivated in Mediterranean countries, though it is necessary there to shade it in the hot, dry summer. It has proved hardy in England also, but seldom blossoms. On our flower-stands it reaches a height of 2 to 3 m., and compares well in size and beautiful leaf-decoration with the finest specimens in Japan.

Owing to the great popularity of conifers in our modern landscape-gardening, and the peculiar beauty of many Japanese kinds, their introduction and distribution has been actively carried on in many places. The first one brought to Europe was *Gingko biloba*, L., and it has shown itself exceedingly well adapted to cultivation here. It is the oldest known from the shores of the North and Baltic Seas to those of the Mediterranean, and withstands the winter cold of Germany as well as the summer heat of the southern European peninsulas. The several varieties of *Biota orientalis* were some time ago introduced in our country by way of Hither Asia.

During the devastating winter of 1879–80, most of the Japanese conifers in Europe proved themselves much better able to resist the cold than those which had been brought to us from the forests of the Pacific coast of North America. The hardiest of all, apart from the two already named, were *Taxus cuspidata*, S. and Z., *Chamæcyparis obtusa*, S. and Z., *Ch. pisifera*, S. and Z., *Thujopsis dolabrata*, S. and Z., *Abies polita*, S. and Z., *A. tsuga*, S. and Z., and *Larix leptolepis*, Gord. The adaptation of these species to forestry can scarcely be doubted. Nevertheless *Abies firma*, like all the Japanese firs of the Picea tribe, shows little advantage over our "Edeltanne," and the same is true of *Taxus cuspidata* in comparison with our yew. The five other kinds mentioned, however, furnish very valuable woods, whose useful properties are greater than those of our well-known forest trees. They are well worth cultivating, and may be introduced to supply gaps in the qualities of our woods. (See also pp. 234–241.)

Cryptomeria japonica, Don., and *Sciadopitys verticillata*, S. and Z., which thrive out of doors only in a specially favourable part of the Rhine district between Basel and Düsseldorf, are much more sensitive to our German winters. We could not expect to make their cultivation a source of wood supply, even if it were especially desirable. In Marburg some attempts made with the two most common Japanese pines (*Pinus Massoniana* and *P. dentiflora*.) showed that their development here is very slow, and that they cannot endure more than 20° C. of cold. The idea of planting the exceedingly useful black pines (*A. Massoniana*) on the North German sand dunes seems to promise no very favourable results.[1]

Of the deciduous trees which recommend themselves partly on account of their valuable wood, and partly because of their beautiful foliage, the following seem best adapted to cultivation in Europe:—*Zelkowa Keaki*, S. and Z. (Keaki), *Magnolia hypoleuca*, S. and Z. (Hô-no-ki), *Cercidiphyllum japonicum*, S. and Z. (Katsura), *Acer cratægifolium*, S. and Z. (Hana-no-ki), *Æsculos turbinata*, Blume (Tôchi). They grow in the rough atmosphere of the mountains and northern portions of Japan, and justify the belief that they may be, at least in part, acclimatized in Germany.

There remain still to be noticed a number of Japanese plants in the gardens and public parks of the countries along the Mediterranean Sea.

There is no lack of warmth and light in this region, but moisture, a third important element in prosperous plant-life, is often wanting. When this is the case, there can be no fine sward cultivation with our known grasses, and various halophytic succulent plants, like Mesembryanthemum, several foreign weeds like Commelina and others may be used to fill up the sod. Special success has been attained with a simple little Japanese lily, the Ja-no-hige, "serpent's beard" (*Ophiopogon japonicus*, Garv.), which has been often called by gardeners by the old name of Convallaria japonica (Japanese lily of the valley), given it by Thunberg. The kindred Yabu-ran (*O. Jaburan*, Loddig) is also employed for this purpose. Even now a fine green turf made in this way can be seen on the Italian lakes, but still more often in Southern Italy, Spain and Portugal. I first found the modest little Yano-hige, with its bluish berries, in the shady places of the temple grove in Uyeno Tôkio. The narrow, dark-green, grass-like leaves of the plant resemble those of the several lighter Gagea species. Its relationship to our lily of the valley is not very close.

North of the Alps and the Pyrenees, the quickset hedges are

[1] I expressed myself in a similar manner in a report which I had to give regarding Japan Conifers, in June, 1884, to His Excellency, the Minister of Agriculture and Forestry.

generally bare in winter, and their commonest material is the white-thorn. In Mediterranean countries, on the other hand, many evergreen bushes are used, as here and there the myrtle, laurel, Viburnum Tinus, Durantha Plumieri, Ligustrum japonica especially, and with even greater preference, Euonymus japonicus, the Japanese Masa-ki. In fact these Euonymus hedges excel all others in beauty because of their uniformity and closeness, as well as the abundance of their magnificent green leaves. Those hedges, which enclose all the roads in Las Delicias at Seville, the public parks of the Corso, and the left bank of the Guadalquivir, especially are surpassingly beautiful. They are kept well trimmed there as almost everywhere, and are about one meter high and broad. This plant is used also in preference for bordering, where we generally use the box. Of course these borders are kept low and narrow, and prettily cut. In other places on the Iberian peninsula also, *e.g.*, Madrid and Lisbon, such hedges are very common.

The hedges made of the *Ligustrum japonicum*, Thunb., the Nedzumi-mochi of the Japanese—for example, those at the railway stations at Seville and Huelva, and also some in Southern France and Northern Italy—resemble in colour our common Liguster hedges, which, it is well known, retain their leaves longer than any other of our deciduous shrubs. The young leaves are at first reddish brown, and even later are not so bright and fine a green as those of the Euonymus. Their colour and shape is most like those of the nearly-related Syringa. But the most important use of both these evergreen bushes is not as close and well-trained hedges, but as ornamental plants for gardens and public parks. We find them in the quadrangular courtyard of the Andalusian hotels and dwellings, in the open squares of almost all Southern European cities, and in every public park. And in such conditions the Japanese Liguster very often passes from a bush to a tree, with a trunk 8–10 m. in height, and of 80–100 cm. circumference. I saw some such at San José near Malaga, in Lisbon also, and on the Plaza Mayor near the royal castle at Madrid. In Italy, where the plant is also very widely distributed, its dimensions are much smaller. *Euonymus japonicus* is less sensitive to cold, and thrives in Southern France and in the parks of Paris. One finds there not only the simple original variety, but the many variegated varieties also, in particular *E. Jap. sulferea.*

I take this opportunity of mentioning several other evergreen Japanese ornamental bushes which are often found in company with the foregoing, and have also found a wide distribution in Southern Europe. These are *Photinia serrulata*, Lindl. (*Cratægus glabra*, Thunb.), Jap. Aka-megashi, *Pittosporum Tobira*, Ait., Jap. Tobira, and *Olea fragrans*, Thunb., Jap. Moku-sei and Tô-sei. Fortune says of the Photinia that it is "a noble, ornamental evergreen," and is much cultivated in gardens and near the temples of

Japan and China. This large, wide-spreading bush is found in many places on the Iberian peninsula, and no open space, in Madrid, for example, is without it. Its large umbels of white flowers lend it a special charm in March and April. Its smooth, serrated and pointed leaves resemble those of the cherry-laurel in their form and size. One of its peculiarities is the appearance of older purple and brownish red leaves against the younger, which are a beautiful green.

The Tobira was introduced into our hot houses in 1804 under the name *Pittosporum sinense*. It grows out of doors in Southern Europe, as in Southern Japan, to a bush of medium height, and during the past two decades has been more and more superseded by its more stately Australian relative, *P. undulatum*. The latter is specially frequent in the parks of Portugal, and particularly in the gardens of Lisbon. It grows as a beautifully formed tree, of 70–80 cm. circumference and 8–10 m. in height. The yellowish white blossoms, which appear in spring, have a much stronger and more agreeable smell than the pure white flowers of the Tobira, which appear some four weeks later. The regular form and even distribution of its leaves also make it more ornamental than the Tobira, whose leaves are oval and crowded together at the end of the twigs. *Olea fragrans*, Thunb., although imported to Europe from Japan, is only an ornamental plant there, originating in China, as its name, Tô-sei, indicates.[1] What *Pittosporum undulatum* is in spring to the gardens of Lisbon, Malaga, and other Iberian cities, that and far more by Olea fragrans becomes in September and October to the gardens and parks of Northern and Middle Italy. Its simple white blossoms then shed their fragrance far and near in the gardens on Lakes Como and Maggiore, in Florence and the Riviera. In Genoa I remember it only in a little park near Acqua Sola.

Besides these, there is a wild olive (*Elæagnus umbellata*, Thunb., *E. reflexa*, Morr.) here and there in Northern Italy, *e.g.*, near Pallanza, which is very popular. It is trained upon houses, and more still on the garden fences, clothing them with a beautiful green, as the long, winding shoots may be easily twined in and out through the iron palings. This plant grows as a medium-sized bush very extensively in the Himalayas, China and Japan, bearing the name of Gumi. It is cultivated also as an ornamental shrub.

Euonymus radicans, Sieb., Jap. Tsuru-masaki, serves similar purposes. Although quite hardy in the warmer parts of Germany, it has not yet received due consideration. It is very widely distributed in Japan as a bush. If it finds anything on which it can lean however, a tree, or rocky slope or a wall, its mode of life resembles that of the ivy. Providing itself quickly

[1] I refer to p. 123, and what is said there concerning the use of the flowers of the Kwei-hwa by the Chinese, in perfuming tea.

with tendrils it lays tight hold of, and mounts up the tall pines to the very top, or often entirely covers the wall of rocks with evergreen. In the Mediterranean region it could perform the same service that Ficus repens does in hot-houses, clothing the naked masonry with foliage.

Shizophragma hydrangeoides, S. and Z., the Shiro-tsuta-no-ki, or "white climbing tree" of the Japanese, is known for similar peculiarities and still greater hardiness. It is one of the largest climbers of the mountain forests of Japan, with a mossy trunk attaining 40–60 cm. in circumference, and sometimes mounts up 15–20 meters high on the rocks and old trees.

There is in the Mediterranean countries a beautiful thornless climbing rose, *Rosa Banksiæ*, R. Br., the Mokoko of Japan and China, which is more of a favourite than the preceding climbers for covering surfaces. Its has shiny, evergreen leaves, and double yellow or white flowers which blossom in spring and in small irregular clusters on the ends of the branches. The yellow variety is the most beautiful and most numerous, and is seen in greatest perfection in the villa gardens on the North Italian lakes. In the snug patios of Cordova, Seville and other Spanish cities, it often covers entire walls, and is seen in gardens winding itself, like the Wistaria, through the crowns of the ornamental trees, and adorning them in a peculiar fashion with its abundance of blossoms.

The traveller from Northern Europe, in visiting the beautiful gardens of Mediterranean countries is struck not only by the luxuriant abundance of plant-life, the motley forms and colours of the deciduous trees, with the evergreens from all sub-tropical lands, but more than all by the appearance of the palms and bamboos in their free and perfect development. If he seeks the homes of these exotic plants, he will find among the palms, in addition to the Japanese Shuro (*Chamærops excelsa*, Thunb.), which is here perfectly acclimated, the representatives of nearly all species of the non-tropical regions of the earth, but among bamboos chiefly the Japanese kinds. These latter are the smaller species and sub-species which the gardeners generally call *Bambusa nigra*, *B. mitis*, *B. aurea*, *B. viridis glaucescens*, *B. viridis striata*, *B. Fortuneï*, *B. pygmæa*, and *B. Kumasasa*. The Kuro-dake or black bamboo is unquestionably the most striking and beautiful of all (see p. 230). It grows in fine wide-spreading groups on Lake Maggiore, reaching its full development at 6 m. height and an average diameter of 3½ cm. According to Tschihatchef,[1] in the Jardin d'Essai at Algiers, it sometimes grows 400 mm. in twenty-four hours.

[1] Tschihatchef: "Espagne, Algérie et Tunisie," p. 164.

MINING.

II.

MINING.[1]

Incorrect Representations of the Mineral Wealth of Japan. Old Method of Mining, and New Attempts to Elevate it. Tabular View of the Productions according to Number, Value, and most Important Mines. Further Particulars concerning the latter, and the single Products. Salt and Alum Production. Products of Clay-pits and Stone-quarries. [Herewith a Map.]

The statistical reports of the products of Japanese mining since the Restoration seem strikingly out of harmony with the traditions, extending back to the times of Marco Polo, regarding the rich mineral wealth of Japan, and especially the abundance of its precious metals. The land was long known among the Chinese and Arabs, and in Europe also, as the Eldorado of the far East—"das güldene Ophir" as Kaempfer named it. According to Edrisi, the very dogs of the country wore golden collars, and according to Marco Polo the roofs, floors and window mouldings in the royal palace were of pure gold.[2]

[1] I have used the following works in treating this subject, as a supplement to my own observations and the friendly oral communications of the Engineers Bansa, Reh and Vogel.

1. Brassert: "Das japanische Berggesetz von 1873." Zeitschrift für Bergrecht. Bd. xxv. (1884), p. 1.
2. Hagmaier: "Reise nach Kosaka and Aufenthalt daselbst." Mittheil. d. deutsch. Ges. Ostasiens. Bd. ii. p. 64.
3. Netto: "Ueber japanisches Berg- und Hüttenwesen." Mitth. der deutsch. Ges. Ostasiens. Bd. ii. pp. 367–405.
4. Rösing: "Das Silberbergwerk Innai in Japan." Zeitschr. für Berg- Hütten- and Salinenwesen. Bd. xxxii. (1884), p. 126.
5. Zappe: "Der Bergbau Japans und seine Haupterzeugnisse." Zeitschr. für Berg- Hütten- und Salinenwesen. Bd. xxvii. (1879), pp. 204–220.
6. "Geological Survey of Hokkaido." Reports by Lyman and by Munroe.
7. Lyman: "Geological Surveys of Japan." Reports.

[2] "Chipangu is an island towards the east, in the high seas, 1,500 miles from the continent, and a very large island it is. . . . I will tell you a wonderful thing about the Palace of the Lord of that Island. He has a great palace which is entirely roofed with fine gold, just as churches are roofed with lead, insomuch that it would scarcely be possible to estimate its value. Moreover all the pavements of the palace and the floors of its chambers are entirely of gold, in plates like slabs of stone, a good two-fingers thick; and the windows also are of gold, so that altogether the richness of the Palace is past all bounds and all belief."—Yule: Marco Polo, vol. ii. p. 235.

It is known that Columbus, in his ever memorable western voyage, hoped to secure these wonderful treasures of Chipangu, described by his countryman.

Even after Japan was really known and the ports of Macao, Manila and Batavia were successfully brought into commercial relations with it, the export of silver appeared to be a further and surer proof of the metallic wealth of the country. But this ceased entirely in 1642, and was replaced from that time by copper, to the great advantage of the Dutch.

After the re-opening of Japan, now more than thirty years since, the inhabitants shared only too gladly the general belief of the foreigners. It was true that their old mines yielded little or no profit, but this was owing, so said many, to the fact that the means at hand and employed for taking out the supposed treasures were not adequate to the task. The thing needful, was to cast off the old system and to make use of the rich experiences and scientific appliances of mining in the Christian lands of the West.

And so there came engineers from America, England, France and Germany successively to counsel and instruct, but after a few years and the expiration of contracts they were generally dismissed, for the conviction deepened that it was not in their power, with all their science and experience, to assure the State or private enterprise a new and large source of revenue. The best and most conscientious among them found themselves encompassed with difficulties and hindrances in adapting their studies and experience to the situation and in establishing a scientific industry. I mention only the serious difficulty involved in not understanding the language, and the impossibility of establishing immediate direct intercourse; the crowd of useless officials that surrounded them; the lack of proper means of transport,[1] added to the unsteadiness and constant desire for innovation on the part of the authorities, who could not patiently wait till the reforms begun should be carried through and tested.

The Japanese had searched their country for valuable minerals, and had exhausted the existing mines, far more than was believed at the beginning of the new era, some thirty years ago. In fact I have not learned that one of the many foreign engineers was able anywhere to discover new openings or beds of mineral. The interest of the nation to find and dig up the treasures of the earth had been from early times a very lively one, as numerous traces of old prospecting and mining, and a fairly rich literature on the subject, plainly show.

Most of the foreign mining engineers who were called to Japan after the Perry expedition, to assist as counsellors and enterprisers

[1] The absence of well adapted means of intercourse, and the great distance of most mines from the coal supply, made the smelting of their products more and more difficult and expensive. For reasons which have been mentioned, this process must take place in the neighbourhood, but since charcoal serves as the means of reduction, the forest not being replenished has gradually disappeared in a wide circle around the mines. This has necessitated the bringing of charcoal on beasts of burden from ever-increasing distances, as Hagmaier relates in the account of his travels mentioned above.

of mining industry, returned home disappointed on the expiration of their contracts. A few, who understood the arts of flattery and thus how to make rich contracts with officials and tradesmen for the delivery of machines and other needed articles, at the expense of the State, remained longer, but these people were least of all the ones to bring about a healthy state of the mining industry.[1] When we look over the annual reports of the results of mining since 1868, we recognise the fact in most cases the efforts made up to this time, have not been able to increase the products in any considerable degree. They only justify my opinion, previously given (vol. i.), that the distribution of metals, like gold, silver, tin, lead, zinc and mercury is very small, and not to be compared with that of other countries, that iron and antimony are to be found in greater quantities, but that Japan is only really rich in coal and copper.

It is evident that the gold and silver mines were much richer in earlier times. They were gradually exhausted, however, under the Tokugawa regime, as far as was possible with their rude manner of working. For even if the estimates and reports of the former metal export (viz., that of gold and silver in the time of Portuguese commerce with Japan) were exaggerated, and are not borne out by the sober judgment of to-day, still it is distinctly stated in the communications of E. Kaempfer,[2] that the Dutch carried away from Hirado a yearly average of 1,200–1,400 chests of silver, 1,200,000–1,400,000 taels, or from £352,941–£411,765 in value, during the period between the years 1600 and 1641 ; that for some time after this, they exchanged their wares for copper instead of silver, and brought away from 12–20,000 pikuls a year, or 720,000–1,200,000 kilogrammes. Reckoned together, this yearly 45–52 tons of silver, and 720–1,200 tons of copper makes a very important amount for those times.

According to government statistics, which however can make no claim to reliability in regard to private mining, the yearly average yield of silver during the years 1877–1881 was 11·64 tons, and of copper 8,900 tons. Thus, in modern times, Japan has for its yearly silver production only the fourth part of what it formerly exported. The amount of copper seems exaggerated, for in 1874 G. Hochstetter, the conductor and counsellor in the chief mining office at that time, estimated the copper production at 3,000 tons,

[1] One of the most competent German engineers gave his experience in the following sharp, but I am told quite correct expressions. "The Japanese is vain, remarkably susceptible to flattery, unsteady and always seeking some new thing. The most unsuccessful attempts were made at mining. Some of the foreign advisers gave poor counsel because of their own lack of knowledge. Many others flattered the childish vanity of the Japanese, in order to fill their own pockets, and found ready accessories, since sharpers have the keen scent and eye which honest men often lack."

[2] E. Kaempfer's "Gesch. u. Beschreib. von Japan." II. Bd. Lemgo, 1779, pp. 89–122.

and three years later, Netto estimated it at 75,423 cwts., not quite 4,000 tons. The production, however, has much increased since then. In 1855 the old copper works of Ashiwo alone yielded about 3,000 tons.

Before entering further into the present condition of Japanese mining, a short retrospective glance at the earlier methods of working, and also the manner of preparing and smelting the ores may be in place. Here, as almost everywhere, the mining of metals and coal was conducted on the plundering principle, which was carried on as long as the water in the shafts permitted, and the ore yielded a small amount of gain. The development of the mine and the excavation of ore were accomplished solely by means of galleries or Ogiri, which went up or down, according to the direction of the lode, but were also run across the strata to effect an opening. The hauling out took place partly through these passages, and partly through the so-called chimneys or Kemuri-dashi, which, however, are not to be confounded with shafts, these being then unknown to them. These Kemuri-dashi are not simple, smooth holes, leading directly to the depths below, but a peculiar arrangement of galleries, which rise and fall, twist about, grow wide or narrow, according as they encounter hard rock or non-metallic soil, or productive lodes and deposits which may be excavated. In many respects this resembles the clumsy, unscientific method of mining among the Romans. But these employed captives and slaves, whereas in Japan, even to the present day, one part of this difficult labour, the hauling out, is done by women and half-grown children. In the Roman and Carthaginian mines, windlasses at least lightened the labour; but in Japan, all the material, ore or coal and waste earth, is carried to the surface in baskets or straw sacks on the back. The name, Kemuri-dashi (chimney) for these upper exit galleries, indicates also that they are used for ventilation. In like manner the lowest gallery serves principally to carry off the water of the mine, wherefore it is commonly called Midzu-nuki, water drain. In these mining operations no machines were employed, except very inadequate hand pumps; and the tools and other appliances were few in number. It is therefore surprising that they reached a depth of from 700–800 feet (212·3–242·6 m.), and that the galleries had a length of 10,000 feet, or 3,033 m.

In these operations, proper sledge hammers were altogether wanting. The work had to be done almost entirely with the help of the pick-axe, crowbar and steel wedge, and, in the absence of explosives, was necessarily carried on in a very limited space. Most of the galleries and short passages are therefore very narrow and low. In former times, when the vicinity of the mines furnished wood in abundance, the excavation was furthered by setting fire to piles of wood in the pits, as was still done twenty years ago in the Norwegian mines, *e.g.*, in Kongsberg. According to Netto, gunpowder has now become general as an explosive in Japanese mines. Its introduction, however, dates only from the year 1872, when the American Pumpelly came to Japan as counsellor of the government of the Shôgun, in the department of mines.

The water control belongs indisputably to the most primitive and inadequate arrangements of Japanese mines, being effected by means of a poor kind of hand-suction pumps, which are often quite insufficient, so that a mine frequently has to be deserted because the water becomes unmanageable. With these defects was often associated a system of mining by contract, which increased the planless plundering of the mines. The owner provided the plant and looked after the water control, and maintained a weak oversight. The contractor undertook the extraction, preparation and smelting.

The preparation of the ores when brought to the surface is effected without machines, and falls into the hands of women and children exclusively, who are much employed in Europe also for such work. First of all the ordinary method, picking by hand, is employed to separate the richer ores from the poorer. Then the latter are further crushed with a hammer, or in the stamping trough (see p. 45) as employed for shelling rice. (There are, however, more perfect stamping arrangements, like ours, with water for a motive power, and an overshot wheel.) Next, the heavier, better kinds of ore are separated from the lighter ore yet to be stamped by a sort of jigging with the help of water, and thus prepared for roasting and smelting. Gold ores, on the contrary, are ground after the hand-picking in hand-mills under a stream of water; and the ore still to be washed is allowed to pass off over inclined boards, grooved diagonally, so that the heavier gold-bearing lumps are caught in the grooves.

The sulphate roasting or calcining of the prepared sulphurized ores takes place not in kilns or open stacks, but in Yaki-gama or roasting furnaces, built up with stones and mortar. These are constructed as a rule on a circular foundation of from 4–6 feet in diameter (121–182 cm.), and to a height of 4 feet (121·32 cm.), and have air holes on one side.

For smelting all sorts of ores, the Japanese use a small, simple oven or smelting hearth, O-doko, or Fuki-doko (big, or blast-bed), with a hand chest-bellows placed at its side. This is called O-fuigo, and is worked by one man. One person is sufficient also for the smelting hearth. This hearth is a shallow pit, 12–15 cm. in depth, and 40–50 cm. in diameter. It has a floor 30 cm. thick, made of a cement of coal ashes and clay, stamped hard, resting in turn upon sand. The fire wall surrounding the pit is a basket work made of thin branches, and then covered close with mortar. Charcoal is the means of reduction in mixing the charge materials. For further details of smelting and of its results, and of mining in general, I beg to refer to the instructive and profitable works, above cited, of Rösing and Netto, which contain also observations on the Japanese mining law. We learn from the interesting book of Superintendent Brassert also quoted, which treats this subject more fully, that Japan, in 1873 (sixth year Meiji), received its first general mining law. It was modelled after the German law in essentials, although leaving great play for the discretion of the government. To the owner of the soil belong only building stone, sand, gravel, lime—in short, substances available for building and agricultural purposes. On the other hand, all metals and their ores, combustible fossils, rock salt, phosphorite, and precious stones are mining property, and subject to the State. The government has free right of disposal over this, which, however, is exercised only in behalf of subjects of the Japanese empire. The investment of foreign capital is forbidden now, as formerly, in mining and in agriculture.

By far the most and often the very best mines are now owned and worked by private individuals. Of late, the government has however let out several of its best mines at comparatively low rates, after having organized their administration anew with the help of foreigners. It is manifest that it finds its method of administering and operating too costly, and the annual expenses too great to continue them.

Mining is a separate department of the Kôbushô or Bureau ot Public Works, under the name Kôzan-kiyoku. This superior mining office represents the eight Bun-kiyoku (branch or mine offices) of the country.

The following table A gives a summary of the yield of Japanese mines during the five years 1877–1881. I have used Momme for gold and silver, and Kuwan-me (pronounced Kamme), for the other products. Table B shows the more important mines of the country, arranged according to the value of their returns in the year 1882.[1] It must be borne in mind that 1 Kuwan-me equals 1,000 Momme (3756·5 gramme), and that 1 Yen equals 1 dollar.

[1] I am indebted for both these tables to my young friend, the competent and energetic mining engineer, Kurimoto, of the Superior Mining Office, who received part of his education at the School of Mines in Freiberg.

Table A.

a.—Production of Government Mines.

	1877.	1878.	1879.	1880.	1881.
Gold . . .	87,433	53,522	50,231	53,925	48,084
Silver . .	2,020,730	1,579,003	1,286,863	1,574,482	2,264,652
Copper . .	112,018	101,115	85,174	67,798	71,225
Lead . . .	36,410	38,803	35,112	29,812	27,984
Iron . . .	——	——	157,357	427,965	514,677
Coal . . .	18,347,343	25,808,943	38,833,844	46,422,080	47,262,595
Coke . . .	18,168	22,590	89,884	117,531	129,366

b.—Production of Private Mines.

	1877.	1878.	1879.	1880.	1881.
Gold . . .	5,988	19,165	19,457	29,392	33,129
Silver . .	924,687	1,058,629	1,136,415	1,182,494	2,498,353
Copper . .	939,301	1,033,908	1,149,635	1,177,398	1,201,246
Lead . . .	36,281	41,814	34,075	42,148	41,220
Iron . . .	2,191,132	2,721,322	2,909,034	3,208,378	3,112,005
Manganese	3,442	11,380	31,540	——	394
Sulphide of Antimony	5,048	46,249	174,048	134,560	104,108
Coal . . .	115,812,298	156,896,323	192,586,134	190,460,983	201,211,707
Graphite .	——	73,142	2,954	1,348	1,300
Petroleum .	404,560	756,812	982,621	1,078,954	708,843
Sulphur .	353,289	573,813	462,981	317,963	186,206
Alum. . .	5,895	4,795	2,138	3,160	6,639
Kaolin . .	4,377,137	4,539,556	5,492,819	6,113,005	6,267,293

TABLE B.

Value of the Production of the Principal Mines in 1882.

(The asterisk denotes mines belonging to Individuals).

Province.	Town.	Product.	Value in Yen.	Value in £.
* Hizen	Takashima	Coal (1884)	1,026,000	205,200
* Iyo	Besshi	Copper	568,519	113,704
* Chikugo	Miike	Coal	410,641	82,128
* Hida	Kamioka	Silver	351,701	70,340
* Sado	Aikawa	Gold and silver	316,163	63,233
* Rikuchiu	Kosaka	Gold, silver, and copper	241,118	48,224
* Nagato	Zomeki	Copper	224,863	44,973
* Ugo	Ani	Gold, silver, lead, and copper	175,147	35,029
* Echigo	Kusakura	Copper	170,248	34,049
* Iwashiro	Handa[1]	Silver	165,690	33,138
* Yamato	Tatesato	Copper	153,763	30,753
* Tajima	Ikuno	Gold, silver, and copper	139,844	27,969
* Harima	Kuratoko	Gold and silver	125,743	25,149
* Ugo	Arakawa	Copper	115,008	23,002
* Iyo	Ôjôin	Antimony	114,163	22,833
* Bitchiu	Nakasô	Copper	113,455	22,691
Chikuzen	Katsuki	Coal	96,265	19,253
* Shimotsuke	Ashio	Copper	95,563	19,113
Echigo	Takidani	"	95,056	19,011
Hizen	Kosasa	Coal	74,433	14,887
* Rikuchiu	Osarusawa	Copper	71,279	14,256
* Ugo	Innai	Gold and silver	70,645	14,129
Hizen	Kishiyama	Coal	64,593	12,919
* Rikuchiu	Kamaishi	Iron	62,844	12,569
Echigo	Fukasawa	Petroleum	61,600	12,320
* Echizen	Omodani	Silver and copper	61,229	12,246
* Mimasaka	Seto	Copper	55,827	11,165
* Izumo	Udô	"	54,348	10,869
Hizen	Shishimachi	Coal	43,018	8,604
* Hida	Kamioka	Silver and lead	40,607	8,121
* Yamato	Wada	Copper	40,491	8,098
* Hida	Kamioka	"	38,860	7,772
* Ugo	Sotta	"	36,961	7,392
Hizen	Kosamurai	Coal	35,294	7,059
* Tôtômi	Sugegaya	Petroleum	34,741	6,944
Hizen	Hirayamashita	Coal	33,778	6,756
Hizen	Nagasaka	"	28,707	5,741
* Bingo	Neshimo Yasuka Mine	Copper	28,642	5,728
Hizen	Tsukinokawa	Coal	28,487	5,697
* Uzen	Aburato	"	27,737	5,547
* Hida	Kamioka	Lead and copper	26,070	5,214
* Uzen	Shachiki	Copper	24,430	4,886

[1] According to E. Naumann (see "Verhandl. Gesellschaft für Erdkunde." Berlin, vol. xiv. p. 229) the amount of silver produced annually from the mines of Handa surpasses that of Kamioka by far.

Province.	Town.	Product.	Value in Yen.	Value in £.
Chikuzen	Seita	Coal	24,067	4,813
* Echigo	Akadami	"	23,567	4,712
Hizen	Namise	"	22,421	4,484
Hizen	Iwaya	"	22,023	4,405
* Iwami	Toyokasegi	Copper	20,885	4,177
* Hizen	Koyagi	Coal	19,582	3,916
Nagato	Ube	"	19,130	3,826
* Bizen	Ishigami	Copper	18,883	3,777
Hizen	Imazuku	Coal	18,804	3,761
* Mutsu	Ennagose	Copper	18,747	3,749
* Kaga	Isengi	"	18,692	3,738
* Tajima	Okuyama	Gold	18,540	3,708
* Yamato	Murasakizono	Copper	17,882	3,576
* Yamato	Kinoura	"	17,342	3,468
* Mino	Hatasa	Silver, lead, and copper	17,091	3,418
* Chikuzen	Shakanô	Coal	16,894	3,379
Chikuzen	Neeta	"	16,680	3,336
Hizen	Hiada	"	16,492	3,298
* Rikuchiu	Ida	Copper	16,210	3,242
* Kitami	Tonehetsu	Sulphur	15,984	3,197
* Chishima	Tôfutsu	"	15,802	3,160
* Mutsu	Sunagose	Silver, lead, and copper	15,558	3,112
* Bingo	Shimoyama-mimami	Copper	15,019	3,004
* Ôsumi	Yamagano	Gold and silver	14,734	2,947
Hizen	Ôchi	Coal	14,525	2,905
* Wakasa	Nojiri	Copper	14,260	2,852
* Rikuchiu	Osarusawa	Gold	14,130	2,826
Buzen	Igeta	Coal	14,006	2,801
* Mimasaka	Bessho	Copper	13,986	2,797
* Hiuga	Kitakata	"	13,656	2,731
* Rikuchiu	Shibanai	"	13,584	2,717
* Harima	Tsurudani	"	12,857	2,571
* Echizen	Yamatakeda	"	12,789	2,558
* Toza	Asadani	"	12,788	2,558
* Rikuchiu	Ôyu	"	12,323	2,465
* Echizen	Kokuro	"	12,323	2,465
Nagato	Suge	Coal	12,250	2,450
Buzen	Ikejiri	"	12,000	2,400
Chikuzen	Katsuno	"	11,371	2,274
* Mimasaki	Kumegawa-minami	Copper	10,954	2,191
Hizen	Sasa	Coal	10,876	2,175
Echigo	Ôarato	Petroleum	10,790	2,158
Hizen	Takuhara	Coal	10,594	2,119
Nagato	Takatomari	"	10,286	2,057
* Bitchiu	Fukiya	Copper	10,266	2,053
Chikuzen	Yoshioka Mine, Yateiwa	Coal	10,240	2,050
Hizen	Yamaguchi	"	10,013	2,003
* Satsuma	Taniyama	Tin	9,752	1,950

Gold, Jap. Kin, Ko-gane and Ôgon, according to Kaempfer came principally from Sado and Suruga. In its original deposits it is now only found in such very small quantities that the yield, even by the most practical methods of working, would not cover the cost. The gold also from the river-beds of Yezo, Suruga and Kai are said to be so insignificant in amount that it scarcely pays the humblest wages.

The celebrated old gold and silver mines of the island of Sado were formerly in the possession of the Tokugawa-Shôgun. They were worked by criminals, and yielded rich returns. These mines are situated in the western part of the island, not far from the capital Aikawa, in a narrow, steep-walled valley (see map) 220 meters above the sea-level. The ore, says Reh, is found in quartz lodes which lie in quartzite rock and extend from west to east. Their thickness varies from 60 centimeters to 6 meters. They contain fine sprinklings of the sulphides of silver, copper and lead, and small quantities of native gold and silver. In 1874, when the Engineer Reh undertook the management of the mines, they were opened up, to a large extent, but yielded that year only about 83,365 yen of gold and silver.

In Kôfu I was shown some beautiful specimens of gold-bearing quartz from the district of the Haya-gawa in Kai (tributary of the Fuji-kawa), but I do not know of any gold-mining in that neighbourhood.

I found in 1875, at Serigano, 2½ ri from Sendai in Satsuma, a similar appearance of gold and silver-bearing quartz, like that of Sado. The lodes contain also some quicksilver, but are very poor as a whole. It is said, however, that the Daimiôs of Satsuma drew a great deal of gold from them in earlier times. The gold and silver works of Yamagano in Ôsumi, whose product so far is very unimportant, were thought for a long time to be the richest gold mines in the country.

Silver, Jap. Gin or Shiro-gane (white metal), is much more frequent in appearance and in much larger quantity than its nobler associate. It is usually found in sulphides like argentite, stephanite, and red silver ore. It is worked off in different ways, as a rule however after an old fashion of melting up the roasted ore with lead (verbleiern) and fining off the raw lead. The best silver mines of Japan are thought to be those of Ikuno, Sado, Kosaka, Innai, Mandokoro, and Ani. In the following list, they are arranged according to their yield in 1882.

a. Kamioka in Hida, bears copper also. The yield of the mine in 1882, of 351,701 yen, is higher than ten years before, when, according to another estimate, two mines of the province yielded 29,760 ounces of silver, and three others 156 tons of copper.

b. Sado, already mentioned under "gold."

c. Kosaka, in the province of Ugo (Akita-ken), in the vicinity of the Upper Noshiro-gawa, and of the frontier of Rikuchiu and

Mutsu, lying about 40° N. lat. has an old mine in a very remote district. The silver is auriferous.

d. Ani, also in Ugo, somewhat south of the preceding, 39° 55′ N. lat. and 140° 30′ East from Greenwich (according to C. von Weyhe, 39 Heft der Mittheil, der deutsch. Gesellsch. Ostasiens) yields more copper than silver.

e. Handa in the north-eastern part of Iwashiro, north of the city Fukushima.

f. Ikuno in the northern part of the province of Tajima, contains with its silver a considerable amount of gold and copper, and is situated on the water-shed between the Japan Sea and Seto-uchi. Nine years ago it was excellently managed by the Frenchman Coignet, so that it belonged to the few mines under governmental control which yielded a surplus. In 1877–78 its nett yield was 70,000 yen, but none of the following years show a like favourable result. At that time there were a thousand men, a dozen Frenchmen among them, employed in the works. The place, formerly a village with scarcely 1,000 inhabitants, had become a town of six times that population. According to Coignet, the mines are 360 meters above the level of the sea, and the temperature occasionally sinks to −14° C.

g. The mine of Kuratoko in the province of Harima yields some gold with the silver.

h. Innai, in Ugo. According to the above-mentioned highly-interesting treatise of Rösing upon this mining district, the principal place Gin-san-machi (Silver-mine town) in the district Okatsu (Oka-tsu-gori) of the Akita-ken, is situated 38° 57′ N. lat. and 140° 36′ East from Greenwich, northward from Yamagata, 235 meters above sea level. Here for nearly 300 years (according to Rösing the mine was opened in 1599), silver, some gold, and lead have been mined. Argentite is the principal ore, then stephanite and dark red silver ore. They are found in lodes which appear in tufa as quartz lodes and calcareous spar, and in some places are several meters thick. The most common and often associated sulphides, pyrites, copper pyrites, sulphuret of zinc and galena are found here, but only in small quantities. The silver ores contain from 0·1–10 per cent.; on the average, however, 2½ per cent. silver and 1 per cent. lead. The silver product contains 1 per cent. of gold.[1]

i. Omodani. This silver and copper mine is situated in the province of Echizen, near the frontiers of Mimo and Kaga. The remaining silver mines yield a very insignificant amount.

Copper, Dô or Aka-gane (red metal) has formed a prominent article of export from Japan since 1642. It is especially valued for its purity. The amount of its annual yield is next to that

[1] The mines of Innai were sold by the government a few years since to a private individual in Tôkio, for the low price of 75,000 yen, and the great copper mine at Ani, for a double amount.

of coal. It is seldom found native, or in oxydized form. Copper pyrites is the chief of its sulphides, out of which at least nine-tenths of all the Japanese copper is extracted.

It is customary to mix the roasted ores (copper pyrites, copper glance, and bornite) with ironstone and metallic iron, and to reduce them in little blast furnaces by means of charcoal.[1] If the crude metal contains silver it is again melted together with lead, which takes up the silver and some copper, and then to set free the silver, passes through the well-known conversion in the refining furnace. I saw this process at Hachiman in Mino. The larger number and by far the best of the Japanese copper mines are in private hands.[2] Table B shows the copper mines of Beshi in Iyo on the island of Shikoku to be the richest in yield of all the mines of the country. It is the well-known Dô-san or copper mountain, celebrated throughout the whole country, which has been worked for a long while. Close upon these mines follow those of Zomeki in Nagato, concerning which I know nothing further—nor of the others succeeding in the list, the mines of Kusakura in Echigo, Tatesato in Yamato, Arakawa in Ugo, Nakasô in Bitchiu, and Takidani in Echigo. The last-named directly precedes Ashio in Shimotsuke in the list. This mining and smelting work is situated 6 ri from Nikkô, has been for a long time (according to Lyman since 1610) in operation, and must be the copper-yielding mine spoken of by Kaempfer as Asingo. I saw in Nikkô pink coloured rock crystals from there and heard that the smelting-house in 1873 yielded 20,000 kilogrammes of blue vitriol besides 500 tons of copper, amounts which according to more recent reports have been greatly increased.[3] The copper mine Osarusawa is situated in the same district (upper valley of the Noshiro-gawa) of Katsuno of the Akita-ken, to which the before-mentioned silver mines of Ani and Kosaka belong. Twelve years ago, this mine was accounted the richest in Japan. It lies 24 ri north-west of Morioka in Nambu whence the copper is brought by beasts of burden, in order to be shipped in flat boats down the Kitakami-gawa to Ishinomaki, and thence by sea to Tôkio.[4]

Our table shows many other copper mines in different parts of the country, and gives evidence that copper is, in fact, the most widely distributed of all the Japanese metals.

Lead, Yen or Namari. The very meagre quantity of this metal is seen in the two lists. Japanese lead mining, consisting of a

[1] The extracting of lead from Galena ore takes place in similar manner by the help of iron and coal as reducing agents. See Pumpelly, "Across America and Asia," p. 147.

[2] The enormous increase in the price of copper during the last twelve months has had great influence on the production and rentability of Japanese copper mines.

[3] See Lyman: "Geological Survey of Japan." Reports, 1878–79.

[4] In the autumn of 1874, on the way from Morioka to the Ganju-san, I met a great many horses and oxen laden with such copper, and heard on the following day that 39 horse-loads of it had arrived to be shipped.

poor galena, does not yield enough for the domestic need. Lead is extracted with silver and copper at Kamioka in Hida, Hatlasa in Mino, and Sunagose in Mutsu. Pumpelly mentions the lead mine of Ichinowatari in Ôshima on the island of Yezo, which he saw in 1863, and reports that at that time it yielded about 80 pounds of lead a day, but three years before 100 pounds daily.

Tin, Jap. Shaku or Sudzu. What has been said of lead is also essentially true of this metal. It is scarcely found anywhere except on the island of Kiushiu, and only in insufficient quantities as shode. Our map notes Tani-yama in Satsuma, which furnished tin to the valve of £3,922 in 1882, and Ohira-tetsu-san, in Bungo.

Iron, Jap. Utsu and Kuro-gane, *i.e.*, black metal. The production of iron in Japan is still small and not sufficient to meet the home demands. It is extracted chiefly from ferruginous sand, and also from magnetic iron ore. The first is a frequently occurring product of alluvium along the coasts, and also inland. It is found oftenest and in largest quantity in the provinces of Iwami, Izumo, and the bordering portions of Bingo and Mimasaka.

The magnetic iron-ore deposits and iron mines of Kamaishi in the old district of Nambu (province of Rikuchiu), are the most considerable in the country. They are located in lat. 390° 18′ N. approximately, 5 ri westward from the bay and town of Kamaishi on the Pacific ocean. They are connected with the harbour by a narrow track. The deposits occur chiefly in the water-shed between Kitakami and the bay of Kamaishi within a circuit of 3 ri in at least a dozen places, generally in diabase rock together with granite. Most of these deposits seem to dwindle toward the depth. Near the surface some of them show a thickness of 40–45 meters. The magnetic iron ore is often mixed with iron and copper pyrites and a trace of malachite and lapis lazuli. It is then coarse-grained and crumbles easily on exposure to the air. The better sort is free from these admixtures, fine-grained and compact. By roasting, the greater part of the sulphur is expelled and a very good quality of iron obtained. This method has been used for 35–40 years at Ohashi and Sahinai, where the ore is said to have been first discovered. I was told that a Japanese, twenty-five years ago, established blast furnaces here after Dutch drawings. I saw them in operation. The construction was old-fashioned, the top-gases not being made use of. The casting is primitive in flat pigs on sand. Ohashi is on the east side, and Sahinai on the west side of the wooded heights which form that water-shed. Fifteen years ago the Japanese government was very hopeful and devised great projects in regard to these iron-ore beds. They wanted to make of Kamaishi another Essen, with or without the help of a Krupp; but nothing has come of it. In autumn, 1874, when I examined the condition of affairs, they were busy with a narrow track 5 ri long, from the mines at Ohashi to the harbour, and erecting two furnaces on the newest principles. These have been for some time in operation, also a puddling furnace; but soon it was found that the quantity of ore remained far behind expectation. The works are now in private hands, the government having tried unsuccessfully to work them with the help of foreign engineers. The desire now is to supersede the constantly diminishing supply of charcoal by coke, and many attempts, for the most part unavailing, have been made to manufacture it from the domestic coal.

A charcoal furnace was built by some English engineers at Nakakosaka in the province of Kôtsuke, but it has returned little profit to its owners up to this time.

The quartzite lodes of the older slate rocks, which are the beds of most Japanese ores, contain besides copper pyrites, the sulphides of iron also in large and available quantities. It is said too (on the oral testimony of the director of mines, Vogel, at Freiberg), that magnetic iron pyrites is much more universally abundant than white iron pyrites, as *e.g.*, in the frontier districts of Bitchiu, Bizen and Mimasaka, where the copper mines of Ichigami, Nakasô, and others are situated. I did not know that these sulphides of iron had been used for the production of sulphuric acid, at all events, it did not occur in the Mint of Ozaka, when the manufacture of this important substance was first introduced into Japan some twenty years ago. On the other hand, the inhabitants have long understood the preparation of Beni-gara or red oxide (Colcothar), which they probably learned from the Chinese. They used for this purpose then as now, the abundant magnetic and iron pyrites, for Beni-gara plays a part not only in their medical science, but is used in many branches ot industry, especially in porcelain painting. In extracting it, the iron pyrites is first roasted, then the calcined ore is leached with water, the copperas crystallized and then heated to a glow. The colour of Beni-gara is more vivid and beautiful red according as the copperas used has been pure in quality, and as the trituration of the heated residuum has been thorough and careful.

The Japanese have only recently become acquainted with the manganic oxides and their uses, and have accepted their European designations. The most important of these, pyrolusite or manganese ore, is found in many localities, chiefly however eastward from Utsunomiya on the borders of Shimotsuke and Iwaki.

Zinc, Jap. Totan, is found as zinc-blende in small quantities. Nickel has not been discovered as yet, and cobalt only in a combination of small value, earthy cobalt, which however, was, formerly of importance in Japan. The Japanese call it Guwa-sho-seï, or Goshu, and according to its different appearance, Seto-konjo, or blue Seto, and its blue extract Yegusuri. Apropos of this, I take from my note-book the following, made during my visit to the porcelain district of Seto in Owari.

"The blue cobalt glaze is interesting. The colour is extracted from a black, earthy mineral (evidently a kind of Asbolite) which serves as a medium of quartz conglomerate. It is found about 6 cho (ten minutes' walk) from Seto, and in several other places in the neighbourhood, always in diluvial gravel. The people drive short adits in these gravel pits, without any timbers or other supports, till they come to the places where the mineral is found in pockets. They carry it out in baskets and pour it out on an inclined plane. The fine sand and gravel remain, but the breccia-balls, which are seldom as large as the fist, roll down, and are picked out and tested by women and children, then sold at the porcelain manufactory. The cobalt colour is extracted thus: the washed material is heated till the medium has become a peach-red colour, then pulverized and washed after separating the worthless stone. The portion which has been thus treated is then precipitated by salt water, the precipitate rinsed and then used."[1]

Antimony, or grey antimonite, Jap. Shirome-ko and Iyo-shirome-ko, *i.e.*, antimony from Iyo. Its real nature and value has only recently become fully known to the Japanese. They did not formerly know how to use the deposits found chiefly in the old slate rocks of the larger southern islands—particularly from Amakusa through Kiushiu and Shikoku,—but now it is a constant and considerable article of export. The antimony mines of the country, those of Ôjôin-mura in Iyo on the island of Shikoku especially, have furnished our mineral collections for some years with the largest and most beautiful crystals of antimonite known.

Table B gives the value of the yield of this and other neighbouring antimony mines, for the year 1882, as over £22,385. The mine is situated south-east of the city Saijo, and not far from the copper mines of Besshi. But there are others also in various parts of Iyo, especially in the south-western portion, as well as in the neighbouring province of Tosa. They are found on Kiushiu at Bungo, Hiuga, and Higo. The island of Amakusa, too, shows several antimony lodes.[2] On the other hand, the find of antimony runs in the direction of the southern schist range (vol. i. p. 32), and in a north-westerly direction over a part of Kiushiu, and Yamato on the island of Hondo.

Coal, Sekitan or Ishi-dzumi. No other article of Japanese mining industry, copper perhaps excepted, is found in so many localities, from the Riukiu islands to Yezo, and no other has engaged so much attention during the last twenty years, nor has any other increased so steadily in the amount and value of its

[1] It is interesting to note that the Chinese name Go-shu means, "Gravel-pit of Go," (the province Kiangsu, where Nanking is situated). We are indeed justified in concluding that Asbolan was found in China also as a cement of gravel, and yielded the blue cobalt for ceramics. At any rate, this popular colour is one of the oldest which was used in both countries for decorating porcelain.

[2] I saw it at Takahama near the west coast in 1875. The lode had a thickness of 16–20 cm.

annual product. Japanese coal it is true, like all Eastern Asiatic coal, is not, so far as is known, as good in quality as the English and Rhine coal. In the judgment of those who understand its qualities, among whom we must class machinists and stokers of steam engines, it belongs to the family of fatty coals, which produce a great deal of smoke, blacken boilers, form clinkers, thus hindering the draught, and cake very easily, without, however, forming a good kind of coke. Lieut. Roberts, of the Perry expedition, for example, reports of them as follows:—

"The coal which we got at Nagasaki was of fourth grade, and poorer than the Australian and American coal furnished us in Hongkong. It made a great deal of slag and dirty ashes, and the fire required to be often stirred. We used 23 tons a day in place of 18 tons of good English coal. The coal of Takashima requires to be kept dry, as when wet it often fires spontaneously."

Japanese coal in most places, if not everywhere, is tertiary coal, and its origin of lacustrine formation. Its recent formation is proved by the many leaf impressions of deciduous plants in the shales accompanying it, but its properties and appearance are like hard coal, and only in exceptional cases resemble those of brown coal.

This is true also of the coal from Diu, on Sachalin, which was examined by the academician, F. Schmidt, of St. Petersburg, and his companion von Glehn. A correspondent of "*Export*,"[1] after enumerating, with this same unfavourable criticism, the properties of the fatty coal of Kelung on Formosa, writes: "As the Japanese coal shows the same defects, the coal of Kelung may compete with it in the markets of Eastern Asia.

Together with such coal—for it is really bituminous coal, notwithstanding its lack of age—may be found also many seams of genuine brown coal in the neo-tertiary strata of Japan, although they are generally thin. Several dozens of such weak seams are often found one over another, separated by some intermediate stratum.

The north-western part of Kiushiu, with the provinces of Hizen, Chikuzen, and Chikugo forms the richest coal district, although Yezo boasts of numerous occurrences of coal. Lyman writes: "One of the principal results of the geological survey of Yezo is the recognition of the fact that on this island there are perhaps 150,000 million tons of workable coal, or two-thirds as much as the coal of the same thickness in the celebrated coal fields of Great Britain. The amount of coal on Yezo would put the island in position to furnish the present annual production of Great Britain for nearly 1,000 years.[2]

The island of Yezo is not known to me by personal observation.

[1] *Export*, VI. Jahrgang, No. 51, Berlin, 1885.

[2] Lyman: "Geological Survey of Hok-kai-do. General Report." Tôkio, 1877, pp. 106–7.

What I could learn from other sources however, and could gather also in part from the export statistics, does not agree very well with this enthusiastic description of its wealth of coal. From all investigations it seems to be evident that the coal of Yezo is no exception to the before-mentioned universal rule, either in age or character, and that in its value and use it will not compare at all favourably with the older English and German coal.

Only a small portion of the coal of Yezo, and indeed of all Japan, is adapted to the production of good compact and pure coke, with a metallic lustre, such as has become so important in metallurgy and so necessary in the modern furnace processes. There are, however, a number of other important uses for their coal, and there is scarcely a doubt that its possession promises much for the future development of Japanese industry and national prosperity.

The best of the already discovered coal strata of the island of Yezo are found in the provinces Shiribeshi and Ishikari. From the latter come the coal of Sorachi, and of Poronai, Horumui, and other places in the Ishikari valley. The shipping of a part of this coal has been rendered possible by a railway from Poronai, *viâ* Sapporo, to the roadstead of Otaru. In the province of Shiribeshi is the coal district of Kayanoma, to which the Honshiki coal belongs also. The thickness of the workable coal strata of the island appears from the reports of Munroe and Lyman to vary from 15 cm. to 2½ m. There are thicker seams in Japan proper also that have not yet been opened. Owing to the more recent geological age of Japanese coal, deep mining, with its costly timbering and ventilation, is not necessary. All existing coal mines begin with coal lying near the surface, and proceed by means of galleries through the running and trending of the stratum.

According to our tables, the coal mine at Aburato, in the province of Uzen, on the Japan Sea southward from Sakata, yields the largest amount of all the mines of Hondo, the chief island. Then follow those of Akadami, Ube and Takatomari in Nagato, lying east of Shimonoseki on the Seto-uchi, opposite the coal district of Chikuzen. This latter embraces a considerable territory on the island of Kiushiu, not only Chikuzen, but Buzen bordering it on the east, and the northern part of the island. Table B places the production of one of its mines, that of Katsuki, after that of Miike. This last very notable mine is situated in the vicinity of the flat eastern coast of the bay of Shimabara, in the province of Chikugo, not far from the boundary towards Higo. When I visited it ten years ago it was still worked by the government. Below the red argillaceous sand lies a thin layer of earthy coal, then follows a stratum of clay schist (slaty clay pebbles) of half a meter thickness. It is full of leaf impressions of dicotyledonous trees, but very much crumbled and broken. Now follows the coal stratum of 2 meters thickness in places, then again the mixed coal and clay schist, and then sandstone. These strata lean at an angle of 20–25° toward the south-east. The mine yields a very good gas coal, and has been known for some 400 years. It passed into private hands about ten years ago, and is now, with one much like it on the island of Sakashima, by far the most productive, especially for export to China.

The Takashima coal is black, lustrous and firm, but light, like almost all Japanese coal when compared with older qualities. It breaks in irregular, prismatic pieces, exhibits a black streak, and furnishes a brownish black powder. It is the best known of Japanese coal, as it supplies every ship bound for Nagasaki, and on account of the favourable location of the mine is most exported.

Taka-shima, a little island of only 54 hectares extent and perhaps 100 m. above the sea level, is situated at the entrance of the long narrow bay of Nagasaki, eight or nine nautical miles from the capital city of Hizen. Grey-white, micaceous, cross-grained sandstone, friable clay in thin layers, and coal strata lean toward the north at an angle of 20–25°. The inhabitants of the island, distributed among a few small villages, earn their livelihood principally in the mines which lie close to the sea on the side toward Nagasaki, and have been worked for about eighty years. In 1875, a private company purchased the mines of the government for the sum of £122,550 In the spring of that year the longest shaft was only 50 meters, still the gallery slanted considerably from this point, following the principal stratum, which is on an average 2 m. in thickness.

The larger coal basin of the province of Hizen, of which Takashima appears to be an outlying member, lies farther to the north. and embraces a number of mines, among which the best known is that of Karatsu, lying not far from the sea.

The occurrence of coal on the island of Amakusa, in the southern part of Hizen, deserves mention also, and in Shiki-mura, near the little city of Tomioka on the northern side. The strata of Oniki, however, on a little bay at the south-west, are thicker and much more valuable.

The foregoing statements regarding Japanese coal were written before the November number of the German "Handels-Archivs" for 1885, with its short statement of the "Import and Export of Coal, and the Coal Production of Japan,"[1] came to hand. I extract very gladly some interesting facts which supplement and corroborate my own observations and opinions. According to this the coal export of Japan for the three years 1882–84 was as follows:—

	Production.	Value in Yen.	Export.	Value in Yen.
1882	327,240 tons	1,197,053	128,230 to China	455,146
1883	391,944 „	1,373,570	126,155 „	407,185
1884	522,211 „	1,828,263	180,950 „	604,676

[1] The statement is made probably by our Consul-General Zappe.

Over against these amounts must be set the much smaller amount of English and Australian coal which was imported for the fuel of foreign vessels, because these vessels are not constructed for burning Japanese coal, which "makes so much ashes and dust." It is feared, too, that the export to China will decrease or cease entirely as soon as that country has somewhat more developed its own coal mines, and provided for the transportation of their products to the coast.

ANALYSES OF THE COAL OF JAPAN AND NEIGHBOURING ISLANDS.

A. Elementary Analysis.	I. Takashima.	II. Miike.	III. Karatsu.	IV. Sorachi.	V. Horumui.	VI. Honshiki.	VII. Midzunuki.	VIII. Kelung.
Water . . .	1·320	0·536	2·690	2·928	8·479	5·360	3·714	3·774
Carbon . .	78·633	69·280	69·436	77·040	68·842	65·221	57·689	73·013
Hydrogen .	5·816	5·524	5·156	5·685	4·771	5·222	4·620	6·313
Oxygen and Nitrogen .	8·721	4·888	11·920	11·014	15·180	10·118	10·144	15·129
Sulphur . .	0·659	3·488	1·177	0·542	0·472	1·607	3·765	1·087
Ash . . .	4·851	16·284	9·621	2·791	2·256	12·472	20·068	4·408
	100·000	100·000	100·000	100·000	100·000	100·000	100·000	103·774

B. Fractional Analysis.	I. Takashima.	II. Miike.	III. Karatsu.	IV. Sorachi.	V. Horumui.	VI. Honshiki.	VII. Midzunuki.	VIII. Kelung.
Water Evaporation. at 40° C. . .	1·32	0·54	2·69	2·93	8·48	5.36	3·51	3·77
Combustible Gases . .	38·13	38·51	40·13	35·03	37·52	35·95	22·98	52·13
Carbon residuum . .	55·45	43·36	47·12	59·05	51·67	46·11	67·51	43·47
Ash residuum	5·10	17·50	10·01	2·99	2·43	13·08	6·00	4·41
	100·00	100·00	99·95	100·00	100·00	100·00	100·00	103·78
Spec. Gravity	1·260	1·335	1·349	1·279	1·323	1·351	—	1·254

Of the coal classified above, I., II., and III. are from Kiushiu, and IV., V., VI., and VII. from Yezo. Their analysis is taken from the work "Yesso Coals, by H. Munroe, Tokei, 1874." Number VIII. is taken from F. Hawks' "Narrative, Perry Expedition"; vol. ii. pp. 167, 168; and IX. from Pumpelly's "Across America and Asia," Appendix, p. 444, XIII.

Petroleum, Jap. Sekitan-yu, Seki-yu, or Sekitan, is found principally in the provinces of Echigo and Tôtômi, but is not sufficient in quantity to supply the constantly increasing home consumption. The chief petroleum district of both provinces lies on the west of a line drawn from the point of Omage-saki on the coast of Tôtômi to Niigata. The production of Tôtômi is concentrated around Sugegawa, but the little city of Sagara is the principal place of the district. Here in 1877 (according to Lyman) 50 wells yielded in all 1,200 barrels of oil, which is superior in lightness and in brightness of colour to that of Echigo. For Echigo, our map gives Fukawasa and Ôarata, mentioned in Table B, as the central points of production. In 1876 there were not less that 522 oil wells in this district, the deepest measuring 732′, or 222 meters. None of them, however, yielded particularly profitable quantities. The entire production was estimated by Lyman at 9,500 barrels, worth 31,650 yen ; but this amount has increased considerably since then, as is seen by the figures given in Table B, pp. 298, 299, as the production of these places.

Sulphur, Jap. Iwô or Yuwô. This is found as a glossy product of sublimation often covering the crater walls and crevices and clefts of active or extinct volcanoes ; but by far the greatest amount of sulphur is formed by decomposition of the sulphuretted hydrogen of the solfataras. As these volcanic manifestations are very widespread in Japan, the frequent occurrence of sulphur is not surprising. Sometimes the suffix " Iwo " in the name of a mountain or an island indicates its presence there.

Satsuma was formerly, says Kaempfer, the principal sulphur producer. The little island Iwô-shima, to the south, also furnishes sulphur. It is obtained at Iwô-dake and Yadake in Hida, from Shirane-san on the boundary between Kotsuke and Shinano. When Pumpelly visited Yezo in 1864, he ascended Iwaounobori from Iwanai on the south-western coast. He saw several solfataras and their effects, and states that the monthly production of sulphur of the mountain was 6,400 pounds, and the total for the year, 38,400 kilogrammes, or 38·4 tons. Our table indicates two other places in Hokkaidô, however, as the most important sulphur producers, viz., Tonebetsu in Kitami, and Tôfutsu on the not far distant island of Kunashir.

Salt, Jap. Shiwo or Shio, up to this time has not been found as rock-salt or in applicable salt springs,[1] but is extracted exclusively

[1] When one considers the great number of hot springs scattered over the whole of Japan, the dearth of salt springs is particularly surprising. The only exception worth noting appears to be Ôshio in Aidzu (Iwashiro). This place which I passed on the 4th of October, 1874, on the way from Wakamatsu to Yonezawa, lies 6 ri from the former in the bason of an old volcanic mountain ring, whose principal rock seems to be grey Andesite. By crossing over a small stream was reached, on whose right bank, to the right of the road, are two warm springs close together. I tested the temperature at 39° and 38° C., and found that each one flowed at the rate of 1 shô (about 1·8 liter) every four or five seconds. The water is weak in salt and rich in iron. A great amount of carbonic acid

from sea-water. The Japanese method of salt-producing is exactly the same as that employed in China, described, *e.g.*, by Fortune.[1] In the summary of Japanese agricultural product, given on page 11, one division of the soil is designated Shio-hama, or salt-coasts. These are flat sandy strips of coast, in all 6,364 chô or hectare, which are devoted to the extraction of salt from sea-water.

The sandy flat coast, to make a salt garden, must lie out of reach of the tide. It is divided usually into fields of $2\frac{1}{2}$ tan or 25 are, each one worked by two men. They smooth it to a perfect level, and cover it with an even coat of well pounded clay. On this they spread a thick layer of coarse sand, carefuly raked over. This is then wet with sea-water, which is carried by little ditches through the garden, and repeated after each evaporation till a considerable amount of salt has been left in the sand. This is raked up together for leaching in a kind of filter, by the addition of sea-water whose amount of salt is thereby greatly increased. The sand is then spread out to dry, and again wetted with salt water, etc., as before. The brine is collected in ditches or tubs and poured into the boiling pans whose construction resembles the contrivances used for drying tea (see p. 118 *b*). These salt pans are usually $2–2\frac{1}{2}$ meters long, $1\frac{1}{2}$ meters broad, and about half a meter in depth. The pans consist of a frame-work of woven bamboo, plastered inside and out with clay cement, and supported by two beams with wooden cross pieces. Wood is used as fuel for the evaporating process, chiefly the branches (and needles also) of conifers. Coal is also used. There are besides large iron evaporating pans called Shio-gama, but they appear to be little in use compared with the arrangements described above.

Japanese sea-salt is far less pure than that from the shores of the Mediterranean, has a grey-white colour, and with 8 to 12 per cent. of water, contains only 80 to 90 per cent. of chloride of sodium. Its preparation is not a government monopoly, as in China, and is carried on in many places along the coast, especially in the south, most of all along the Japanese Seto-uchi (Inland Sea), on the coast of Iyo, Sanuki, Awa and the provinces of Sanyôdô. The coast of Satsuma also has salt fields already mentioned, *e.g.*, at Akune. At Kanazawa, in the vicinity of Yokohama, a considerable amount of salt is produced.

According to Geerts,[2] the yearly salt production of the Japanese

escapes from it, and much ferric hydrate is precipitated. It is said to have been used many centuries for salt extraction, but for the last twenty years it has flowed unutilized into the brook. Ascending still higher along the road, I found a third weaker salt spring with 20° temperature, this change proceeding from cold water flowing into it.

[1] "A Residence among the Chinese," pp. 305, 306.

[2] "Les produits de la nature japonaise et chinoise." Yokohama, 1883, p. 308. This book contains many valuable statements, which unfortunately, however, must be used with care, owing to the lack of judgment with which others of a different character are mingled with them.

coast is estimated at 5,700,000 hectoliters, distributed as stated above, over 6,364 hectares of salt gardens, making an average production of 895 hectoliters to each hectare during the seventy or eighty dry summer days. This amount does not compare with the returns from the salt gardens of equal area on the Mediterranean coast. It must be especially borne in mind, however, that the climate of the latter, with its dry air and rainless summers, is incomparably more favourable, and therefore the production can be carried on in an entirely different way from that of the eastern monsoon district with its numerous summer rains.

Alum, Jap. Miô-ban (Miyô-ban) has been known for at least 1,200 years in Japan, and is used there, as with us, as a mordant in dyeing. It is frequently found native in a white earthy decomposition of volcanic rock, which has taken place by the action of solfataras. This Ji-nen-han or natural alum is extracted, and the pure crystals are formed in the solution. It is generally called Ban-seki or Han-seki, alum stone, but is not to be confounded with it. I saw beautiful alum at an Exhibition in the spring of 1875 at Funai, the capital of the province of Bungo, which is considered the principal place for its production. Shinano, Kôtsuke, and Hida are also mentioned for their alum.

Porcelain stone, Kaolin, Potter's clay. A number of different products of the decomposition of felspathic rocks are used in the extended, and in some of its branches highly developed, pottery industry of Japan. They are called in Japanese, Ishi, stone, and Tsuchi, earth, according to their nature, while usually the different species are designated with the name of the place where they are found. We divide these ceramic materials into two classes according to the agencies which have wrought the decomposition of the felspathic matrix, viz.:

1. Porcelain stones. Peculiar products of the decomposition of trachyte, euritic porphyry and other volcanic rock, rich in silicic acid, and appearing in unstratified masses. Their decomposition was probably brought about by the influence of the sulphides of hydrogen and aqueous vapour of the solfataras. To this class belong the most valuable materials of Japanese porcelain manufacture, the Arita-ishi of Hizen, the Amakusa-ishi of the island of Amakusa, the Kutani-ishi and Nabetani-ishi of Kaga, and others beside.

The solfatara (Jap. Jigoku, hell) affects not merely the vegetation in its vicinity, but also the rock. It bleaches trachytic and doleritic lava, and works an entire transformation in them. The silicic acid, among other things, is often separated as stalactite, and then appears as a medium of a new cementation, as is shown very distinctly in Amakusa-ishi. Pumpelly observed a similar transformation by the solfataras, at Yu-nonai—the solfataras of Iwanai on the island of Yezo—concerning which he remarks as follows: "The hot springs here are in close connection with snow-white quartz porphyry. This rock is impregnated with iron pyrites, which in many places is only indicated by cubic cavities containing sulphur."[1] The bleached Liparite of the Lipari Islands, and the grey-white Rhyolithe of Hungary are perhaps the results of similar changes under the influence of solfataras, at least they resemble strongly the Arita and Amakusa rock, concerning the chemical composition and employment of which more will be said in the section on Ceramics.

2. Disintegration. Products of common felspar and kindred minerals and rock rich in argillaceous earth. Kaolin belongs to this class, and the plastic clays in their varied modifications, even to common loam.

The principal sources of porcelain stone and Kaolin, the basic material of fine pottery, are indicated in the tables with the products of mining industry proper, and will be further treated under Ceramics.

Porcelain stone and Kaolin, are taken from the surface of the ground, and do not therefore belong properly to mining, but to the Gioku-seki-rui, the family of stones which are obtained from the quarry, Jap. Ishi-yama (stone mountain), or Ishi wo, hori-dasu tokoro (*i.e.*, place where stone is dug out). It has been shown in the first volume of this work, that freestone proper, and stone in general, has had but very subordinate use in building, *e.g.*, for the massive walls of old fortresses, stairs leading to temples located on heights, stone turrets, monuments, bridges, pavements of temple courts and gardens, cooking hearths, wash-basins and rice troughs. For these purposes they used almost without exception granite, especially the Mikage-ishi from Settsu, and the Teshima-ishi from Bizen, besides trachytic and doleritic lava, as well as the older slate. Common limestone is burned and its powder (Ishi-bai, *i.e.*, stone powder) is used as a manure, but seldom for building purposes. Marble, called Rô-seki and Sarusa-ishi by the Japanese, is found in several parts of the country, in Bizen, Mino, and Hitachi. Some statues in and around temples, from the white marble of Hitachi—quarried near the coast north of Mito, the capital—show that it is spendidly qualified for the purposes of sculpture. From the variegated marble (Fusuline lime) of Akasaka in Mino, a variety of small articles are cut, among them saucers to rub India-ink in.

Slabs of old slate, Seki-ban, or Date-ishi, are used for paving walls in gardens and courts, and large ones for small bridges over streams and irrigating ditches.

The greyish blue slate which resembles our slate used for pencils in hardness, colour, and grain, is employed very extensively in the manufacture of India-ink saucers. The best known and most celebrated for this purpose is the Amabata-ishi from the province of Kai, whose quarrying and working, owing to the large demand, has

[1] Pumpelly: "Across America and Asia," p. 177.

furnished employment a long time to a large number of labourers. The method of polishing is similar to that employed for rock-crystals, Jap., Suishô, agates (Menô-seki) and related semi-precious stones. The most celebrated source of rock-crystals is the Kimpu-zan in Kai, where the beautiful twins, in certain of our collections, were found. Agates, cornelians, and chalcedony, occur in Echiu and Idzumo, being also worked there. For polishing all these hard stones, garnet sand is used (Kongô-sha, *i.e.*, sand from the Kongô-san, a long mountain ridge in Kawachi on the right of the Yoshino-gawa). But this kind of stone-work belongs properly to Art Industry, and will therefore be discussed more in detail in the next section.

ART INDUSTRY AND RELATED OCCUPATIONS.

III.

ART INDUSTRY AND RELATED OCCUPATIONS.

"Quam quisque norit artem in hac se exerceat."
—*Cic. Tusc.*, i. 18, 41.

1. Japanese Art Industry in General.

Revival of European Art Industry.—Growing Interest in the Productions of the Chinese and Japanese.—China the Master and Model of Japan.—Characteristic Features of Japanese Art-handicraft and its Products.—The Period of Highest Development and the Means of its Advancement.—Its Influence upon that of the Christian Countries of the West.

One of the most conspicuous and lasting effects which may be credited to the great International Art and Industrial Exhibitions of the last three decades, is undoubtedly their influence on the revival of interest in art industry. The first conception of such a great universal exhibition was formed in England, and from that country also the first intelligent impulse toward the important matters of art industry has spread rapidly abroad among the Christian civilised states of the West.

Since then, by means of instruction and illustration in schools and museums, it has been sought to revive the much sunken and deteriorated art handicraft afresh, to awaken the feeling for the really beautiful in industrial products, or, as it has been expressed, to ennoble taste and thus to advance trade and industry.

First of all, proportion and harmony were to be studied and fostered. These two conceptions, most important and far reaching in every art, are no less necessary in art industry. They embrace everything which form and decoration must offer in order to meet our ideal sense of beauty, which Plato ranks so high as to attribute it to a divine origin.

These earnest and energetic efforts to elevate art industry by means of collections and instruction, and so to advance national labour and welfare, were not displayed in Germany till after several neighbouring countries had furnished us good and successful examples. We soon made up for our neglect however, and already see the fruits of the greater energy which our Governments, together with many private interests, have shown. We can but observe what has been accomplished for example in textile products, and especially in embroidery, or compare the artistic forms and decorations which to-day distinguish the work of our gold and silversmiths, with the many awkward and tasteless specimens of preceding periods.

Bad models, abundantly set and followed, spoil the taste as inevitably as in morals bad examples corrupt good manners. Good designs of figure and decoration are thus necessary also in art industry, in order to refine the taste and to guide tastes already refined. To obtain them we went back to the operations of art industry in the Middle Ages, and even farther, to the antique. They were sought and found also in the far Orient, among Arabs, Persians and Indians, and even beyond the boundaries of Aryan nations, among the Mongolians of the Chinese system of civilization, especially in China and Japan. The manifold productions of Japanese art industry in particular, which are brought to Europe and North America by almost every ship, and reach even the smallest inland cities, have exercised a powerful influence on many branches of Western European art industry. This has been shown to a surprising degree in the Industrial Exhibitions of the last sixteen years, notably in the great Paris Exhibition of 1878. So much has been written concerning it, as well as of the history and peculiarity of Japanese art industry, that it may seem almost superfluous for me to attempt in the following treatises to discuss the subject in a comprehensive and perhaps a somewhat original way. I am moved to it by the consciousness that I had a better occasion and opportunity to make a thorough study of the art handicraft of the Japanese than has been the case with most of its reviewers hitherto.

Architecture, which among Aryan nations has the most notable and powerful influence upon art industry, has not developed any such high significance in Chinese civilization. All its architectural creations are perishable wooden buildings, and only exceptionally make any monumental impression. The most important are Buddhist temples, which seem weighed down and burdened under their disproportionally heavy roofs. They exhibit a multiform wooden ornamentation which may indeed be the expression of a rich fancy, but seldom however, with the exception of the carving, is a sign of a particularly developed artistic sense.

Art industry among those Eastern Asiatic people has its centre in the many little productions which they form out of plastic clay, metal, wood, and ivory. These are richly decorated partly with lacquer and enamel colours, partly with engraving, chasing, inlaying with metal, and an extremely tasteful use of curves, and even more of straight and broken lines. So also is it in textile industry, from simple weaving to the most complicated silk or cotton fabrics. In Japan as in China, it is in the art of lacquering, fine ceramics enamel, chasing and inlaid work, especially bronze work and forging of weapons, also wood, ivory, bone and stone cutting, and in the weaving and colouring, that the feeling for art and the artistic skill of the people show themselves.

China is the original home of these branches of industry. Japan has received them thence as well as the most of its peculiar habits and decorations. Chinese state polity and jurisprudence, Chinese letters and literature, Chinese ethics and medicine, Chinese art and industry with all their peculiarities of operation and tendencies of taste, all reached Japan, and mostly by way of Corea, with Buddhism, the great base and supporter of the particular Eastern Asiatic civilization which includes China, Corea, Japan, and a part of Farther India.

Japan has regarded China as her model in all these departments for many centuries, and has developed great aptness of imitation and skill in the use of its acquirements, but on the other hand very little independent creative power. The indisputable fact that it now far surpasses its old masters in the most extended branches of art handicraft, is to be attributed to this very gift of imitation, and inclination to appropriate what has been seen and to make it useful, and above all to its own developed sense of beauty in nature and art.

The relics of Japanese industry before the time of the ascendancy of Chinese influence, which have become known chiefly from excavations, show that the country at that time occupied a very low plane of artistic ability and taste. There is a great resemblance in the forms and decorations of these ceramic discoveries to the first phases of cultivation in many other and widely separated nations. The forms are awkward, inclining to spherical shapes, and the decorations simple. As in all young civilizations, the older people of Japan before their contact with Chinese and Coreans in the first centuries of our era, beside simple lines and dots, imitated animals instead of plants in their decorations.

In Europe, from the Middle Ages onward, so-called free academic art, *i.e.*, painting and sculpture, forsook art industry altogether, went its own way, and soon was far in advance. In Eastern Asia it was entirely different. Here free art has remained far behind art industry, and has been only partially developed. The Eastern Asiatic has been for centuries especially hampered by conventional forms in the pictorial representation of the human body. He paints after an old traditional type, no matter how little it may be like nature.

A dreary naturalism on the one side, and the free play of an exuberant fancy on the other, rule the art industry of Eastern Asia. But nowhere else have these traits been so thoroughly cultivated. We find together with a highly developed sense and comprehension of the beautiful in nature and in art, an inclination toward the grotesque and unsymmetrical all the more striking with a surprising and fascinating truth in design and execution, a strongly marked fancy and tendency to irregularity and caricature; with a high technical perfection, numerous failures in perspective and proportion. The frequent departure from line and symmetry in their decorations offends our eye and feeling something as in certain of Wagner's compositions, *e.g.*, in Siegfried, the many dissonances which follow a passage of harmonious accord offend the ears of many a lover of music.

This love of the Japanese for the *bizarre*, the unsymmetrical, and in our eyes, the unlovely shows itself not only in art industry, but in their gardening, for instance in the way in which they arrange their flowers, and especially in the frequent treatment of the pine or Matsu (*Pinus Massoniana* and *P. densiflora*), in their gardens. Their eyes delight in its deformed figure, in its unnatural and disproportionately long horizontal branches. Specimens which have been made particularly monstrous in this way, *e.g.*, the old pine of Karasaki on Biwa Lake, are accounted among the most notable sights of the country and attract visitors from far.

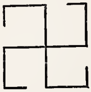
Many of the productions of art industry, as well as the examples of architecture, show that constructive art is far less advanced among the Japanese than decorative art. We seek in vain among their works of an industrial character for "the noble restful greatness of the Greek masterpieces" (Winkelmann), which distinguish also Greek ceramics. Many of the Japanese models, like the temples and Daimiô fortresses, which were formerly the chief repositories of art, are clumsy and dwarfed. But with these, however, there are many which, for lightness and attractiveness of form, satisfy the most refined taste. Nevertheless their principal skill is unquestionably in the line of decoration. Their compositions show well controlled exactness and strength, and charm by their life and truth to nature, their often masterly colouring and the high technical perfection of their embellishment.

Most of the slender, airy, well-proportioned art forms of Aryan nations are either wanting or are so changed as to be beyond recognition. In their ceramics and metal industry we miss entirely the beautiful vase and jug-shaped Amphora, Hydria, Lekythos, and Oinochoë, while Krater and Kantharos appear in numerous modifications, especially among bronze vases, because they are so well adapted to hold loosely the blooming stalks placed in them. The beautiful shape of the Indian sarai, which is used so much of late for water and wine flagons made from crystal glass, has been much changed in the Chinese and Japanese imitations in porcelain and bronze. That which has been most retained is the spherical enlargement at the base, but in place of the narrow slender throat is one wider and far less pleasing, often with wing-like appendages, and even griffins at the mouth of the vase. The form of the Greek wine jar has never become domesticated, notwithstanding it has been so often introduced into the country among the presents of the Portuguese and Dutch. Cylindrical vase-forms, copied from the bamboo cane, as well as polygonal and prismatic shapes, seem peculiar to Chinese and Japanese art industry. In the ethnographical collections of Europe they are known only from these sources. The Romans, it is true, had prismatic glass bottles on a quadrangular, hexagonal, or octagonal base, these angles disappearing rapidly toward the top in a short, wide cylindrical throat (the square prismatic being urns for holding the ashes of the dead), but in the ceramics of antiquity such forms it appears were not imitated. Whatever may resemble them in Indian and Persian art industry is most likely of Chinese origin.

In the art industry of the Aryan nations—Indians, Persians, Arabs, Greeks and Romans, and in Christendom also—symmetry and proportion seem to be the first principles of ideal beauty. They form the ruling feature of true artistic execution in all these countries. In their patterns style rules, *i.e.*, they show in both decoration and form an ideal stamp that may often diverge widely from the natural object which first suggested it. Especially is this true of decorations which the Aryan artist generally evolves from his own thoughts and mostly without paying any strict heed to nature. The contrast to this in the prevailing decoration of the Japanese and Chinese is very great, especially where the style of the Indians, Persians and Arabs is in question. The *motifs* of these Eastern Aryans are only exceptionally taken from nature, and even then are conventionalized beyond all recognition. The straight line plays with them only a subordinate part. Curves and flourishes of every sort, combined in every possible way, but still symmetrical and orderly, distinguish their work. Their principal charm is in this harmonious arrangement—the charm of all conventional decoration. This peculiar adaptation is not entirely wanting in Japanese art industry, but it falls into the background in comparison with the realistic side. It goes by the name of Kara-kusa, *i.e.* China weed, among them.

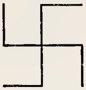
In the realistic exact copying of natural forms, especially of plants, birds, insects and sea animals, also various quadrupeds, such as monkeys, rabbits, rats, and in the representation of clouds, rocks, and water scenes, the Japanese have great skill and remarkable execution. The drawing answers sharply and definitely to the pattern in expression and action, and fascinates the beholder with its exactness no less than by the ease and delicacy of the perfect execution. This is the principal charm of the productions of Japanese art industry. In all surface decoration, the use of arabesques and other ideal curved ornamentation falls far behind the conventionalizing of straight lines. The Vitruvian curve with the Gammadion and Hook-cross (Chin. Man-tse, Jap. Man-ji) and geometric figures play a conspicuous part. The first of these is never found in the subjects of Indian and Perso-Arabian art industry, and the last named only in exceptional cases.

No symbolic design was so much used in ancient times as the Hook-cross. It is found on Scandinavian, Celtic and Gallic coins and ornaments, also on Etruscan terra cotta amphoræ, and on old Egyptian monuments where it signifies immortality—an attribute of Osiris and Horus.[1] It is also a design in many of the forms of Greek art. In India and Eastern Asia it is the symbol of wisdom and the thousandfold virtues of Buddha. The busts and statues of this divinity often display it worn on the breast, especially in Farther India, as was shown on the two gilded statues of Buddha at the French-Indian Colonial Exhibition in Antwerp some years ago. The Hook-cross of western nations, including Egypt also, is distinguished from that of the Buddhistic East by a secondary claw on the arm of the cross. The arms of the Eastern cross also have often an opposite direction, as the accompanying sketches show.



a

A GREEK HOOK-CROSS.



b

BUDDHIST.

c

GAMMADION.

The Japanese call the Hook-cross Man-ji; the Chinese, Man-tse, the word "Man" meaning "ten thousand." By another arrangement of the four Gamma of the Hook-cross, the Gammadion is formed, which is not only nearly related to that of the old Greeks but is much used as a pattern in surface decoration in the art industry of Eastern Asia. The heliotype of the inlaid vase (see Metal Working) shows the connection of the Man-ji with the Gammadion on both sides of the vine-representation.

The non-appearance among the Aryan Orientals of the Vitruvian curve which is so important an ornament in Grecian and Christian art, its frequent use again in Chinese and Japanese art industry, is certainly striking, although, so far as I can learn, it has never been noticed before. Is this beautiful design spontaneous among both Greeks and Chinese, or has one of these nations borrowed it from the other, or is its origin to be found farther back, among the Assyrians and Chaldeans? Such questions suggest themselves, but are not so easy to answer as might appear at first glance. The separate zone of the Arabo-Persian-Indian district from which the Vitruvian curve is entirely absent, points towards spontaneous origin and use, as well as the circumstance that it is found on the cotton fabrics from the old tombs of Peru, though it is not so perfect in them.

The art industry of Eastern Asia employs the Vitruvian curve usually as a border decoration. The vine and other creeping plants serve the same purpose.

[1] According to P. Cassel: "Literatur und Symbolik." Leipsic, 1884.

The Chinese origin of most of the forms and *motifs* of the productions of Japanese industrial art is easily recognised. Pæonies and chrysanthemums, the iris and the lotus flower, the slender, graceful bamboo, and deformed, bizarre pines, leafless and blooming branches of the mume plum and the magnolia, leafy branches of Kerria and the wild cherry, the creeping Glycine with its hanging clusters of blue flowers, the evergreen Nandine with its red berries, the so-called seven autumn weeds, especially the ornamental Eulalia, Lespedeza, Patrina and Hisbiscus mutabilis, the flag, rush and arrow-head; rock and water scenes in gardens with fishes and turtles, cranes, herons, pheasants, the Japanese nightingale (Uguisu) and other singing birds, insects in motion and at rest, then the animals of the Chinese zodiac,[1] and several others like the elephant and the peacock, renowned in Buddhism and Chinese legends. These are the natural objects chosen by the Japanese as well as the Chinese. Four others are also associated with them, the Shi-rei or four animals of good fortune, fabulous animals, viz., the Hôwô or Phœnix, Riyô (Tatsu) or dragon, the Kirin or unicorn, and the Ki (Kame) or turtle.[2] The dragon is pictured on the Japanese coat of arms. Curled up like a snake, scaly, with the most horrible expression of the head, a distorted animal figure, it is found not only on the imperial escutcheon and coins, but everywhere imitated, in bronze, in wood and even in woven fabrics. It is the emblem of vigilance and strength. An animal which appears more often than the unicorn, and as its substitute, is called the Kirin; it has the head and breast of the dragon, the posterior portion of its body like a dog or cat, and the mane of a lion. It often forms the knob on the cover of urns and smoking utensils, and is as much of a favourite for this purpose as the lotus bud. The Hôwô is seldom represented in reliefs, much more frequently in fabrics. The turtle is very popular especially the Mino-game (mantle turtle) *i.e.* a turtle with long green confervae attached to its shell. It is the symbol of a peaceful old age, one of the seven felicities of human life.

Another group of decoration-designs, employed extensively in bronze reliefs, is from the Buddhist mythology and the old

[1] The Chinese zodiac consists of the Rat, Bull, Tiger, Rabbit, Dragon, Serpent, Horse, Goat, Monkey, Cock, Dog and Wild Boar, answering to the Ram, Bull, Gemini, Cancer, etc.

[2] In the Rei-ki, or Relation of Ceremonies, one of the five classic works of the Chinese, they are classified briefly and in another order: Rin, Hô, Ki, Riyô. They are the kings among beasts and stand at the head of the five classes of the animal kingdom in the old Chinese natural history, as follows:—

1. Man stands at the head of all naked animals.
2. The Kì-lin (Jap. Kì-rin) or the Unicorn leads and protects all hairy animals.
3. The Hôwô (Fung-hwang) or Phœnix represents the feathered creation.
4. The Riyô (Lung. Jap. Tatsu) or Dragon stands at the head of scaly animals.
5. The Ki (Kwei, Jap. Kame) or Turtle represents and protects all animals provided with a shell.

Japanese sagas and heroic legends, which furnish abundant material. To this group belongs the representation of the Shichi Fuku-jin, or the seven gods of good fortune.

Certain combinations exist as a rule in all the subjects borrowed from nature. The most general of them are: the bamboo cane and the tiger; the mume plum and the nightingale (Uguisu); sunrise with the pine and the crane; the lion and the pæony; the deer and the maple; the crane and the turtle (symbols of happiness and long life); the pine bamboo and mume; the bulrush and the silver heron; bamboo-cane and sparrow; rain or willow and swallow; lotus flower and silver heron. The homeward flight or alighting of wild geese, the awakening of nature in spring, the snowfall and other natural incidents furnish popular decorative themes. (Compare Table VII.)

The Chinese representations of these and other objects are frequently clumsy and not very true to nature. Especially with tree-forms their wild fancy plays wayward tricks, putting leaves and flowers together which belong to very different species or are not to be found at all. Their work often shows glaring colours and tasteless combinations, particularly in the ordinary market wares. For example, at the great Paris Exhibition of 1878 there was to be seen a Chinese screen with paintings on silk which represented among other things, a blue convolvolus which twined itself around the blossoming branches of a pomegranate tree; on the tree was a fanciful bird with a yellow breast, and on a rock at the foot stood a cock toward which a dragon fly was flying. No Japanese artist would choose such combinations, because they are unnatural, and his sense of colour would forbid him. China maintains its conspicuous rank among the countries of Eastern Asia, because of its size and its commercial and political importance; but in its bearing toward Christian civilization, in its government, institutions and its influence upon our industrial art, Japan is far in advance.

Though the Japanese were for centuries blind admirers and imitators of their Western neighbours and masters, they are so no longer. In the beautiful scenery of their own country they find the most of those decorative themes which have been introduced from the West in clumsy and distorted forms. Many of these objects, especially those which their own hills cannot furnish, they plant in their gardens and the parks of their temples, and what they admire and gaze upon with such pleasure here, the natural productions of their own land, become their subjects in art. To delight in nature, sitting quietly at her feet to watch her in her life and work, and to render back the fleeting and pleasing picture with warmth and truth as it was felt and seen, this is gradually becoming the foundation principle of Japanese industrial art.

The pictures with which the Japanese love to adorn their vases and trays, their screens and costly silk embroideries, are therefore the expression of a refined taste, of practised observation of nature, and a loving appreciation of all the beauty which mountain and valley, wood and field in all their manifold forms and phenomena can spread before him.

"Natura artis magistra"—this motto of the Zoological Garden of Amsterdam suits no people better than the Japanese. It does not stand written on the products of their art industry, but the eye of the connoisseur recognises it and its full significance in them, and admires the freedom of treatment, the surprising force of expression which the Japanese artist knows how to unite with great truth to nature, especially in the representation of birds and insects and many of the popular flowers.

Who will dare to deny that this is the true, the fully justified Naturalism? The artist takes his subject from nature. He seeks to represent with devotion and truth the utmost beauty that she offers, uncorrupted and unfalsified by any addition of his own fancy or of a low and obscene taste. Not that the latter is wanting in the Japanese art world. It was formerly very prevalent, but has been repressed by the better judgment and co-operation of foreigners and natives of higher aim and cultivation.

That tendency of our realistic art toward the representation of dreadful scenes where blood and the odour of death prevail (*e.g.* those of the celebrated Brussels painter Wiertz, or Benvenuto Cellini's well-known bronze statue in the Loggia at Florence) has never found approval with the Japanese. And it betokens a better development of our own taste, when this bronze masterpiece, "Perseus, standing on the body of Medusa," with the severed, blood-dripping head in one hand, and in the other the sword triumphing over its bloody work, is being regarded everywhere as an unworthy and cruel theme for art. The choice by many artists also of subjects from daily common life, in so far as they are immorally and unæsthetically handled, cannot stand before a strict artistic judgment, and is at any rate not Fine Art. In every art, realism has its justification and its limits. The latter cannot be embraced in one short rule, but are defined by a moral power which governs and translates the sense of what is beautiful.

The question whether art must be moral, indeed, whether it always can be, is a very old one, and long ago occupied Grecian philosophers. Each individual answers it according to his own taste and inclination. Obscene representations, however artistically perfect they may be, are without question a misuse of art, which should educate and form a proper taste. For this reason, the Venus di Medici, which is quite in place in a museum, is surely not suited for a school.

In the many decorative subjects which have been borrowed from Japanese history, and especially from the great Buddhist mythology, the old warriors appear in clumsy armour checking all free movement, and the court people in stiff ceremonial dress, but generally in remarkably expressive positions. The men are always represented with full beards, as up to the time of Shogun-Yomorito in Kama-kura (1185–1199 A.D.) it was the universal custom to wear this appendage. The representations of Buddha as a mild, blissful divinity, of feminine appearance, in his several occupations of blessing, teaching, and meditating, as expressed by the position of the hands and fingers, show a great deal of artistic ability.

Religion has been at all times and among all peoples the most potent stimulant and support of art and art industry. To represent deities, to beautify their worship and the temples dedicated to them, inspires not only artistic working of wood, stone, and metal, but leads to progress also in textile industries. It may be generally accepted that the higher men rise in their conception of God, the more artistic and spiritual will be the representations of the embodied divinity. There is, however, no generic difference, but only one of degree, between the rough forms of wood and clay of uncivilised nations, and the perfected and beautiful Grecian and Christian art. The ideals and grade of civilization in any nation are seen more clearly in its art and industry than in its laws and history.

With the introduction of Buddhism, as has already been said, the language, literature, and art industry of China was spread abroad throughout Japan. What had been accomplished in the latter up to this time was of no high grade, and in its forms and ornamentation was not unlike the productions of our own heathen ancestors. Buddhism was, till the middle of this century, the principal promoter and patron of art industry.[1] In Buddhist temples and cloisters the best efforts found application and preservation, so that the inscription at the entrance to the South Kensington Museum—"Quam quisque norit artem in hac se exerceat"—was appropriate in these also.

As feudalism developed under the Minamoto, and still more since the tranquillizing of the country under Iyeyasu at the beginning of the seventeenth century, the feudal nobles (the court nobility was too poor) constituted themselves the patrons of art industry. The castles of the Daimiôs and the temples became from this time the places where its best productions were collected. The dynasty of the Tokugawa-Shôguns (or the Tycoon) in Yeddo, *i.e.* from the battle of Sekigahara in 1600 to the restoration of the Mikado government in 1868, is the golden age of Japanese art handicraft. The long peace and the equally long closure of the country served to bring its several branches to stronger and more individual development. The germs of this development were planted in Japan by the long intercourse with Corea and China—which latter country had served as a model for over 1,500 years—and as the outcome of an expedition to Corea, organized in 1586 by Hideyoshi, and on this new and fruitful soil had grown

[1] Siebold calls the Buddhist religion "Conductrice des sciences et des arts," in his "Sur l'état de l'horticulture au Japon." Leide, 1863.

and reached their best period during a long and undisturbed season of nurture.

The condition and ability of Japanese art industry in the first half of the seventeenth century can be understood best by its various accomplishments in Nikko. After this beautiful site[1] at the foot of the wooded and well-watered mountains had been chosen for the resting-place of the great Shôgun Iyeyasu, by his own wish, and his body had been removed thither from Ku-nô-zan in Suruga, the nobles and most faithful followers of their dead master and leader made great exertion to pay him all possible respect in death. The temples and pagodas which they founded, the granite columns and water basins, stone and bronze lanterns as well as many bells, the wood carving in relief and open work, the priests' robes and utensils, lacquer work and many other articles preserved from that time, furnish indubitable evidence that art industry had even then attained a high degree of perfection. Its further advancement is seen in many beautiful articles from the tombs of the Shôguns at Shiba and Uyeno in Tôkio, and in many celebrated temples of the age following. Several art connoisseurs consider the reign of the eleventh Shôgun, Iyenari Bunkio (1787–1836 A.D.), as the real golden age of Old Japanese art industry.

Finally, after long practice, and after the opening of the country to foreign commerce, New Japan appeared in the markets of the West, with its manifold productions of lacquer art, with its ceramics, its enamelling of copper and earthen vessels, its bronze industry and its forged weapons, with its splendid silk fabrics and embroideries, and its bewildering variety of playthings and fancy articles by which it won very rapidly the admiration of nearly all patrons of art, and at the several international exhibitions competed successfully with the civilized nations of Christendom. Like the mountain streams which, after long obstruction, at last suddenly pour forth over the plain, flooding and enriching it, these products of Japanese industrial art surged into the markets of Western Europe and exercised more or less influence on the taste and efforts of many of our artisans and artists.

The feudal system of Japan and its barriers had been overcome, the Daimiô fortresses had fallen, the cloisters had been robbed of a large part of their support, and with this the former supports and patrons of its peculiar artistic handicraft had disappeared. Most of the art collections of the country went into foreign lands, to enrich public and private exhibitions ; many were squandered away at ridiculously low prices ; and the fear became widespread that the old skill would die out, and the art industry of Japan degenerate. This anxiety was well-founded, in so far as the foreign exporters of these articles now had them manufactured in quan-

[1] See illustrations on pp. 302, 456, and 462, vol. i.

tities in the treaty ports and in the interior, at the lowest prices, since their whole aim was to make as much money as possible. The artisans themselves forsook to a great degree the old patterns and the old methods of work, and sought eagerly for new forms and decorations to please European taste, which hitherto they had not known. The most tasteless things, considered so by the Japanese, thus reached their market and found their customers.

But unexpectedly, with the revival of our own art handicraft, and the spreading of an educated taste abroad in Europe, there came a turning-point in this corrupting tendency in Japanese art industry. The number of connoisseurs and amateurs of the pure industrial art-productions of Japan increased, the demand for them grew, and a new impetus was given to industrial efforts, greater and more powerful than any previous influence. This turning-point is due not a little to the effect of the great industrial exhibitions upon all interested Japanese, the government as well as the artisans. The degeneration feared by so many, the ruin of Japanese industrial art, has not come to pass ; but, in many departments, I mention only enamel and bronze work, there has been remarkable progress during the past fifteen years.

The conviction has been reached that the future of Japanese art industry lies in the preservation of its individuality. Only while the Japanese people retain their childlike joy in the beautiful scenery of their country ; while they keep up the careful nurture of their favourites in wood and field, temple-grove and house-garden, continuing to draw from this living and ever fresh source their themes and artistic inspirations, and do not lose their satisfaction therein—the main ground of their happiness and of their cheap labour-power—only in such case will they keep their place at the head in their peculiar industrial and artistic productions. Only thus can they hope to preserve the market they have gained, and to adapt themselves to it anew.

In the feudal days of Japan, as has been said, the finest products of art industry went to the adornment of temples and dwellings of the barons. They were generally made to order, and the princes vied with each other in developing and maintaining conspicuous talent. This gave the artist an undisturbed leisure and joy in his creations. When it is maintained however that in recent times many persons in the higher classes of Japan showed not only interest in art industry, but occupied themselves with it—that even princes and ministers modelled and painted lacquer ware, it must be owing to a great misunderstanding of existing circumstances. Dilettanti of this sort are much rarer there than with us. Verse-making or poetising was always fashionable even in the highest circles, and so was painting probably, but these circles have played no such noticeable part in the development of industrial art as has been sometimes reported. In Japan, art and art industry do not dwell in palaces, but in the modest little wooden dwellings of poor but contented and happy people, whose needs are few and easy to satisfy. Their products are called Te-zai-ku, *i.e.* "fine hand work."

The apprentice advances through a long and, in our eyes, a hard schooling to the rank of journeyman, from journeyman to master, and it is only when talent, diligence, and perseverance are combined that the highest rank can be reached—the place of a leading, progressive artist. But the whole people, from the highest in position to the lowest, show interest and comprehension for the productions of industrial art, and in this fact may be found undoubtedly a powerful means of its advancement.

The eye and hand of the Japanese are on the average more practised than those of the European. Even the ordinary man can generally make a fairly clear sketch of an article or a route. Why is it? Is this keener artistic sense, this greater executive ability of the people, inborn or acquired? I think the latter, and believe that the key to the problem is chiefly in the difficulty with which Chinese and Japanese letters and characters are learned. It takes years of practice and great diligence for the eye to distinguish them quickly, and for the hand to imitate them easily with the India-ink brush. But in this way the eye acquires great facility in recognising and grasping form and proportion, and the hand the dexterity to reproduce them both with truth.[1]

The Japanese combine with their artistic skill not only a great imitative faculty, but also much inventive power where small art-conceptions and surprising effects are concerned. The inventive spirit of the American is a speculative one, directed to the devising of useful working-material and contrivances, some of which are known in England and America as "Yankee notions." The Japanese, however, invent little artistic trifles instead. In the one case the spur to invention is the lightening of hand labour by substitution of other means. Here, it is the joy of artistic creation, without any reckoning of the material benefit to be gained.

In speaking of Japanese influence on the art industry of the Christian West, it seems best to distinguish three periods of commerce with this land of the sunrising, viz., the Portuguese, Dutch, and modern. The period of the almost exclusive commerce of Portugal with Japan covers the last half of the sixteenth century. After the discovery of the country by Mendez Pinto in 1542, Portuguese Jesuits, led by Francis Xavier, introduced Christianity into the southern and middle parts, with such success that many thousands were converted. The influence of these followers of Loyola grew noticeably, until in 1582 some Christian princes of the island of Kiushiu sent an embassy with rich presents to the Pope at Rome and the court at Madrid by way of Lisbon.

[1] If the comparison be allowed, I would remind the reader here of the Slavic nations and the well-known ease with which they acquire foreign languages. The difficulties of their mother tongue exercise ear and tongue in such a way as to fit them for a quick comprehension and use of foreign idioms.

These gifts, as well as all the other industrial products of Japan which may have reached the Iberian and Italian peninsulas at this time, did not exercise any direct influence upon the art industry of those countries any more than did the Portuguese priests and merchants at that time trading there.[1] As these latter were banished from the country during the first decades of the seventeenth century, Europe found she had gained little from her eighty years of intercourse with Japan save the increase in her historical and ethnographical knowledge. This interesting country remained a *terra incognita* for the naturalist particularly, and its investigation in this respect was only begun toward the end of the century by the German E. Kaempfer.

During this long period (1624-1854), in which Holland alone maintained and only in Nagasaki the intercourse of Europe with Japan under very profitable but very humiliating conditions, many valuable industrial Japanese products were brought to the Netherlands. For a long time after, these articles were, so to speak, foreign to the rest of Europe, as they only reached the private collections of individual princes. They were principally urn-shaped covered vases, of Hizen porcelain, and even in Holland only exercised a noticeable influence on ceramics. There flourished at that time (1639–1764) the celebrated Faïence manufactory of Lambertus Cleffius in Delft. It followed the tendency of the time, and painted its pictures on hard, burned tin enamel, while in the preceding period the colours had been laid upon air-dried enamel sheaths, and burned with them, so that the decorations were much lighter and more delicate in form.

The painters of the establishment were now greatly inspired by the new decorative designs of the Japanese models, as were also those of many other Dutch manufactories of the time, all of which called their wares porcelain, some of even receiving patents for their correct imitations of the Japanese, *e.g.*, Pinaker. The Japanese patterns were not followed in material, but in their forms, and still more in their decorations. We find represented on the products of this expanded Dutch Faience industry, for instance, the Botan (*Pæonia Moutan*), the Mume (*Prunus Mume*), the Matsu (*Pinus densiflora*), and other specimens of Japanese flora, also cranes, silver herons, peacocks, etc., after their Japanese models.

[1] My hope to find these presents and other products of Japanese industrial art of that time in the collections at Lisbon, Madrid, or Rome, or in Portuguese cloisters, and so to have some firm basis for a judgment of the work of Japan in the sixteenth century, was not fulfilled, greatly to my regret. The investigations which a well-informed friend made for me last year in Rome proved as fruitless as my own in Madrid, Lisbon, and the vicinity. Don Fernando, the late king and art patron, who was an excellent judge of industrial art-productions, and who had the kindness to take me himself through the Lisbon collection, was of the opinion that Portugal possessed nothing from that period. The same is even more true of Spain, whose capital does not yet possess any ethnographical or industrial art collection.

As, however, in the eighteenth century, Faience with its opaque tin enamel was more and more displaced by the successful operations of this porcelain manufacture, in Europe the Japanese patterns vanished also, and were superseded by Chinese, as we can discern especially in the older specimens of Meissen and Sèvres ware. The earliest products of Böttger and Tschirnhaus, the so-called "red porcelain"—stone and earthenware of a reddish brown jasper colour, such as eighty years later was supplied by Wedgwood in England—consist mainly of tea-pots, a part of which, in colouring, form, and decoration might be confounded with many manufactured in these days in China, *e.g.*, with those in the province of Shantung. In the same way the hard porcelain made in Meissen from 1709 resembles in every particular the Chinese models. In later times, the decorations of Meissen, as of other places, forsook more and more the East Asiatic patterns, and kept only a few conventional fragments, like the blossoms of the rose, pæony, and mume plum, which, deprived of their other constituent parts, they combined with arabesques and other ideal decoration, forming pictures which made up in symmetry and beauty of form what they lacked in truth to nature.

In Sèvres too, where in 1695 they had already begun to manufacture a kind of porcelain, but did not understand before 1768 how to imitate the hard Chinese variety, the decorations were at first a simple copy of the Chinese, and only took on by degrees an independent character.

And now comes the noticeable and widely extended movement of modern times, quite outside of all connection with these earliest influences of the ceramic art of Eastern Asia on the noble pottery of Europe, and far removed from them in point of time. This new movement toward the Japanese art of decoration, which does not aim to copy blindly the Japanese forms, has been observed only within the last fifteen years, or in exceptional cases ten years earlier, and first found expression at the Great Exhibition at Vienna. It was caused by the great popularity of this Japanese decorative art in fashionable circles, and of Japanese products, after the old barriers to their export had fallen. France and England, hitherto the countries which set fashions in industries of all sorts, have also gone the farthest in the new direction. Setting aside the evidence of the Vienna Exhibition, we see the Japanese influence on the industry of these countries, especially in ceramics, decoration of bronzes, gold and silver work (less in other branches of industry), and this was shown especially in the Paris Industrial Exhibition.

Among the ceramics of the French Exhibition of 1878 there were imitations of Japanese patterns in porcelain and terra cotta, and many especially in Faience. The specimens of Faience from Gien (Loiret), and of Choisy le Roi (Seine), should be mentioned as remarkable productions of this kind. The great manufactory of Gien exhibited plates whose decorations were not distinguishable from Kutanityaka (Kaga porcelain), and the imitations of the censers of Satsuma were as surprisingly true. The porcelain painter, L. Cellière, of Paris, has developed great taste and skill in imitating Japanese masters; also F. Gaidan, who copies Awata-yaki (Kioto Faience) remarkably well, and has distinguished himself particularly by his free use of Japanese manner. Majorelle, a manufacturer from Nancy, produces good copies of the lacquered Imari vases.

If we turn our attention to the exhibitions of Paris bronze work, which was brilliantly represented at the Universal Exhibition of 1878, Barbedienne naturally first enlists our interest. Of all Frenchmen he has accomplished most in general bronze manufacture, and especially in the employment of imbedded enamel, and is almost the only one who has succeeded in imitating Japanese cloisonné enamel, and using it in surface decoration. This he has done with great success, though not indeed in a financial sense. Not content with mere imitation, he aims to use more familiar decorative themes after the Japanese manner, which in our eyes is a much more valuable service. He exhibited a large plate with the central design of a pond with white water-lilies, while water lilies (*Butomus*) and yellow blooming iris surrounded one side, and a wild duck was just settling upon the water surface. Blackberry bushes, vines, twigs of oak, oats and reeds, as well as several other plants belonging to our domestic flora, were used on other bronze articles with a corresponding application.

Over against these truly noteworthy accomplishments are others in which the Japanese have been copied in a most senseless and ridiculous way. Of this kind was a fire screen, from the firm of Bouhon & Co. Its bronze decoration, which rested on woven wire in a broad brass frame, was intended to represent the branch of a pine whose needles had been transformed into shield-shaped leaves, the blooming twigs of the mume plum forming the ramification. To add to this unnatural combination, a silver heron was placed on the horizontal part of the branch. "Make what you will, somebody will praise it," wrote the "Wandsbecker Bote" (Claudius) once to his friend André. So here also; the article, priced at 300 francs, was five times ordered, as a placard stated, evidently just because of this artistic combination.

What Barbedienne is to the manufacture of bronze ware, Christofle is to gold and silversmith's work in France, and even more as a galvano-plastic plater and decorator of nickel-silver and bronze. His wares are chased partly before and partly after silver plating. Often after plating, the engraved ornamentation is gold plated or enamelled in black, with especially fine effect. Christofle employs Japanese decorative themes very frequently; an entire division of his large and rich exhibition was devoted to Japanese styles.

If one wished to know the influence of Japan upon English art industry, he had only to look at the most brilliant part in the British section of the Exhibition, the productions of the five following great houses, viz., Elkington, Minton, the Royal Porcelain Manufactory of Worcester, H. Doulton and Thos. Webb & Sons. The exhibition of Elkington, the most celebrated English silversmith, included chiefly useful articles of gold and silver and electroplated nickel wares. Japanese models played a large part in the varied ornamentation, and generally were employed with great taste.

In Minton's porcelain manufactory at Stoke-upon-Trent, which imitates the varied Faïence of earlier times, and had an extraordinarily rich collection in Paris, there is scarcely one Japanese theme that has not been used. Especially noticeable were the cups in the colouring of the Awata-yaki, each with its mume plum and flying nightingale (Uguisu) charmingly painted on a shield of violet ground. But who will pay 105 francs for such a work when he can get the same cup from Japan for a few dollars?

The Royal Porcelain Works of Worcester, the second great manufactory of English china, in its efforts to imitate Satsuma Faïence, discovered "ivory porcelain," with a colour between that of Satsuma and Awata-yaki, resembling ivory more than either however, and well-suited to its name. It is a notable specialty of this factory, and not only the decorations but in part the Japanese forms also are imitated very successfully in its prismatic and bamboo-cane vases, basins, etc.

There are many Japanese copies also in the work of the great London Faïence factory of H. Doulton at Lambeth, and in many other of the English exhibits of fire-clay wares. The factory which shows the least Japanese influence among the five mentioned above is the glass works of Thomas Webb & Sons.

The United States of America appeared also in the Champs de Mars. Among their exhibits, I note that of the firm of Tiffany & Co., New York, which received one of the three great prize-medals in the department of Orfèvrerie. A large part of its heavy silver ware was decorated in Japanese designs with fishes, butterflies, crabs, herons, iris, garlands, etc., partly engraved and partly in relief. The ceramic industry of America was but slightly represented; but nevertheless the Japanese section of the "Centennial Exposition" in Philadelphia, 1876, has had a surprising influence upon it. Where formerly it was the custom, even in the households of the rich, to use plain white plates and cups, from this time, wherever possible, everybody would have them decorated in Japanese style.

Most of the other countries which were represented at the Paris Exhibition made but little display in this direction. Russian art industry for instance, has held itself entirely independent of Japanese influence, and preserves more than all others its own national character. But the porcelain works of Stockholm, which, as also some of our German factories, are furnished with a very fine raw material in the white-burning felspar (Mikroline) from the neighbouring islands of Ytterby, have evidently felt the impress of the new tendency and taste. The celebrated factories of Rörstrand and Gustavsberg, which are among the oldest in Europe, and have received high distinction in competition with other countries, seemed to have taken from the Japanese partly the form and decoration and partly only the *genre* of the latter. Under the first class there were two four-cornered vases—not at all successful copies—painted with Japanese girls who showed the blonde hair of the Scandinavians. But wherever they had freely followed Japanese manner, only in fine antique forms, *e.g.*, in two other vases ornamented with Swedish grasses and wild flowers, the truth, and free, easy and forcible treatment delighted every art lover.

My consideration of Japanese art industry is almost ended. On page 4 of the beautiful work of C. von Lützow, " Kunst und Kunstgewerbe auf der Wiener Weltaustellung," J. Falk says especially relative to Japan, " By means of Universal Exhibitions, the highly coloured and decorative art of the Orient has come forth from its isolation and retirement. It has become a great power in Europe, making itself forcibly felt in its industry, and threatening in some departments to entirely revolutionize its taste." If this expression was justified by what followed the Vienna Exhibition on the Prater in 1873, it is confirmed still more by the development in art industry shown in 1878 on the Champ de Mars in Paris. I do not consider an entire revolution in European taste through Japanese influence possible in any branch, but rather a continuance for some time yet of blind imitation of Japanese models. They have in my opinion no direct steady value, but serve indirectly, through refinement of taste and its wider spread among us, to work against a one-sided unnatural conventionalism, and to lead us more to nature as a teacher. It is not the blind imitation, but acceptance of the light, pleasing manner of their art, that will essentially aid our art industry and tend to the further development of that fine taste of which the French minister, in his speech at the distribution of the prizes in Paris, 1878, said so aptly :

" Le goût est la fécondité du travail."

WOOD-INDUSTRY.

Furniture making.—Inlaid Work.—Peculiarities of Turnery in the Hakone Mountains and Nikko.—Comb-cutting.—Straw Mosaics.

It has already been stated that Japanese architecture, like that of Eastern Asia generally, is not, as in the European civilization, the oldest and most eminent exponent of art, but that its wood structures lack much in solidity, adaptation and elegance, besides being an easy prey of fire. The Japanese show their inventive genius, skill and perseverance in woodwork of an entirely different character from building, viz., in the hundreds of little articles which they manufacture from this material. Therefore it is not as carpenters and architects that their peculiar talent and taste is distinguished, but as joiners, turners, and wood-carvers. The frames of the Shôji or window panes, the wainscotting of the walls in many of their temples, and numerous other works, are samples of their fine and careful joinery.

The very simple way of living and the household arrangements among all classes of Japanese people, excluding as it does the use of heavy furniture, does not tend to develop any individual style of cabinet-making. The principal work of manufacturing the few wooden household articles, such as chests, sword stands, *étagères*, screens, dining-tables, trays, sedan chairs, etc., falls to the lacquerer, who paints the light and neatly made frames and groundwork of pine with the precious varnish, and decorates them with his skilled and artistic hand. Now, however, in modern times and with the necessity to furnish the houses of foreigners and natives after European style, artistic cabinet-making has been developed and attempted with growing success, not only in making common furniture, but above all in fine wood mosaic work called *intarsia* or *marquetrie*. And in this line the most excellent results were very soon reached. A peculiar kind of wood-working is wrought in the Hakone Mountains, and at Shidzuoka, the capital of Suruga. The cabinets, commodes, and tables ornamented with wood inlaid-work, are very much prized and already many of them are exported. For inlaying, the yellow-brown wood of the camphor laurel with its silky lustre is chosen. Also the black pith-wood of kaki, or the persimon tree (*Doispyros kaki*). The wood most prized for all kinds of cabinet-work and for turnery also in part, is that of the keaki (*Zelkowa keaki*), already mentioned in this connection on page 242. It is used by itself alone much as our oak, but serves also as a stout framework in the large amount of intarsia work, for tables and commodes, neither splitting nor warping, and showing off the light-coloured mosaic in its dark colour and fine flecking very advantageously, like a dark picture frame. It is also very useful in turning and carving, as for instance in the pipe-case in the illustration, Fig. 1, p. 133.

The wood-work of the Hakone mountains,—a day's journey from Yokohama,—which goes by the name of Hakone-zaiku, (Hakone-work) consists mainly of these mosaics, and a great variety of small articles turned by the lathe, very cheap, and extensively exported. I need only mention the little ash cups standing on one foot, made from the wood of the Sanshô (*Xanthoxylum piperitum*, (p .255), the black-veined light plates and bottle stands of Sotetsu *Cycas revoluta*) and the heavier ones of Hari-no-ki (a sort of alder) which have the same appearance, besides the different boxes, some of which, if opened, show that they are intended for candlesticks, and other things, as cigar cups, all made from this peculiar-looking alder wood. The busy people of the Hokone Mountains, who support themselves in this way, keep the preparation of Hari-no-ki (*Alnus incana* and *A. firma*) a secret, and pass off the articles made from it as the product of Tsuta-no-ki (*Actinidia volubilis*, Planch.) whose extremely light, large-pored wood is not really very similar. It is not difficult however for the searching, practical glance to penetrate the secret in the Hakone villages, Hata, Kawabata, Miyanoshita, and several others where this work is extensively carried on, as well as in the little city of Hakone itself, and the bathing resort, Atami. This secret lies in the fact that the trees are felled in the neighbouring woods in spring, when the wood is full of sap. The branches and tops are cut off, and the trunks sawed into lengths of about two meters each, and then left to lie in their bark during the warm, rainy summers, being often turned. The wood in this way becomes mouldy, its red colouring matter undergoes a chemical change not yet investigated, becomes dark brown, and collects in particular places, so that the wood assumes a dark, spotted appearance. In turning on the lathe, both of these changes, the mouldy character and the peculiar marking, show distinctly through the colouring. After polishing with shave-grass, the articles are put back upon the lathe, pressed close to a piece of vegetable wax (Rô, see p. 158 ff.) and turned, which gives them a smooth, shiny surface, at the same time filling the pores with Rô.

The turning-lathe just mentioned is a very simple apparatus. The turner has the main element, an iron axis, with one end, a four tined fork, turned towards himself. The other end of the axis rests and moves on a support in the middle of a pan. Between them is a twisted strap ending underneath in two treadles. The workman sits with the legs in a box-like recess, to which the straps with the treadles reach. When he moves the treadles up and down like the blower at the bellows of an organ, the horizontal axis is turned not in one direction, but now to the right and now to the left. The turner places the thick cross-section of wood on the before mentioned fork, and according to his wish turns a narrow or a wide cup-like hollow in it, and then forces in one end of the piece of wood out of which he wishes to form the article.

Nikko-zaiku (Nikko work). In the celebrated temple and pilgrimage place, Nikko (Imaichi) there are a comparatively large number of shops which deal in simple lacquer wares for home consumption, and also with peculiar carved and turned woodwork. The former come from Wakamatsu in Aidzu, the others are manufactured in Nikko itself, and it is these which are called by the above name. The articles are neither so various and beautiful nor so prized as those from Hakone, but are very peculiar. The woods of the camphor laurel, alder and other trees, so generally used there do not play any part in Nikko. What gives Nikko ware its charm is the individuality of its shapes, and the materials employed in making it. Roots and pieces of branches of the Shakunagi (*Rhododendron Metternichii*) are stripped of their bark, and hollowed out for bowls, ash cups, water dippers, and other purposes, then lacquered on the inside, and provided with a lacquered cover. Old cork-like Polyporus is treated in the same way, and furnishes a quantity of hollow vessels which attract by their want of symmetry as well as their originality.

Comb-cutting. The Japanese till now have made by far the greatest part of their toilette and small-tooth combs of wood, and used for this purpose chiefly the heavy, thick wood of several evergreen trees of the southern part of the country. The following observations and memoranda relative thereto were gathered at Sawa-mura, in the province of Idzumi, on the way from Sakai to Wakayama. Comb-cutting is carried on here in many of the houses. The woods employed are chiefly the following, arranged in the order of their estimation; 1. Tsuge (*Buxus japonica*, p. 246), 2. Isu or Yusu (*Distylium racemosum*, p. 251), 3. Tsubaki (*Camellia japonica*, p. 259). The relative price of the combs made from these woods is 8 sen, 2 sen, and 1 sen each. Ginger, or Ukon, is often used to give camellia wood the yellow colour of box, but cannot impart to it the more important qualities, equal fineness of grain, hardness and toughness. The imitation is otherwise very deceptive. Yusu wood is easily recognised by its reddish brown colour. It comes, like box, from Kiushiu, by way of Ôsaka and Sakai. It is soaked in water for a longer or shorter time as necessity may require, in order to prevent splitting. As in the case with Tsubaki, the wood of kindred varieties is used also, *e.g.* of Mokkoku (*Ternstroemia*), but much less frequently.

A sort of division of labour exists in this industry. One man saws the wood into plates, another with a circular saw cuts out, a third files, grinds, and polishes the prepared comb. When it is to hold up and adorn the hair of a girl or a woman, it is as a rule ornamented by the lacquerer.

In Yabuhara on the Nakasendô also, the comb manufacture occupies many hands, but the softer deciduous woods of the neighbouring forests are used here, and the wares are cheap and inferior.

Straw Mosaic, Jap. Wara-kise-zaiku. The most common way of ornamenting many small articles of Japanese woodwork, and at the same time protecting them against the effects of weather, is by lacquering, about which the following chapter will give more extended information. There is another decorative art by means of a sort of mosaic work. Intarsia, or the inlaying of different coloured woods, such as is carried on chiefly in the Hakone Mountains, has already been mentioned. A third method is the overlaying of wooden ware with plaited rattan or straw. The first is seen chiefly on the oval bread basket, the outside of which instead of being lacquered is often covered with fine rattan braiding, glued on, also in egg-shell porcelain.

It is more often the case that straw mosaic is used for decorating small wooden ware. These are little cabinets, boxes, bowls, and other articles commonly made of Kiri-wood, which are very popular because of their lightness. The most beautiful of them are sent from the province of Tajima to the treaty ports. These, as well as the favourite straw toys of children, made also at Omori, on the Tôkaidô, between Yokohama and Tôkio. Barley straw split and coloured with aniline dyes is used for mosaic work. The ornaments are first placed together after a pattern on bast paper, and glued on with Fu-nori or some other paste, and then in the same way fastened to the wood. Even in this work, the common labourer manifests a cultivated taste in the arranging and contrasting of colours that is not to be found in any other nation.

The manufacture of toys, or Omocha, belongs also to this small-wood industry (I recall only the koma or top) in which the Japanese show themselves very skilful and careful workmen. We turn now another branch of industry in which these qualities are manifested in a far higher degree.

Lacquer Work.

Prefatory Observations.—Manner of Obtaining the Japanese Lacquer; its Properties.—The Urushi-kabure or Lacquer Poisoning.—Preparation of Raw Lac for the Lacquerer.—Prices of the Material. —Other Materials and Utensils needed in the Work.—Laying on of the Groundwork and Simple Lacquer Ornamentation.—The Work of the Lacquer Painter or Makiye-shi.—Plain and Relief Gold-lacquer Decorations.—Lacquer Carving.—Historical Items concerning Lacquer Work.

Prefatory Remarks.

Among the many well developed branches of Japanese art industry, lacquer work undoubtedly takes the first place. In no other have the feeling for art and artistic ability of the Japanese, their free play of fancy, and their admirable perseverance and skill in executing their richly figured pictures, developed earlier and more. In none have they so quickly disengaged themselves from their Chinese masters and patterns and stood more independently, and finally in no other have they so surely won eminence among all civilized people.[1] Besides, in scarcely any other branch of their industry is the employment and use of the raw material so varied,

[1] Father d'Incarville, 128 years ago bore repeated testimony to the superiority of Japanese lacquer work over that of the Chinese, from which it sprang. The English designation "to Japan," is likewise intended to signify lacquering.

the purposes and excellence of the articles it serves to adorn so manifold, as in the case of the Japanese lacquer-work, and the industry which gives it value.

The great superiority of the Japanese lacquer wares is not only the result of several excellent properties of the peculiar lacquer,[1] but is also based on the careful manner in which that excellent material is used. Japanese articles of this kind are distinguished by greater lightness and elegance of appearance; by their solidity, and the beauty and spirit of their decorations; principally, however, by several very valuable elements in the material itself. To these belong:—

1. Its great hardness, in which the Japanese lacquer varnish far excels all others, even the copal, tar, and asphaltum, without showing brittleness or becoming cracked.

2. Its high lustre and the mirror-like surface of the carefully laid-on lacquer coating, especially the black, qualities which are preserved under the most different atmospheric influences for decades, and even centuries.

3. Its resistance to a number of agencies which attack and destroy our common resinous lacquer varnish.

Thus the Japanese lacquer is not injured by boiling water, or hot cigar ashes; it withstands even alcoholic liquids of all sorts, and acids, at least when cold. The hot, sharp, salty soup of the Japanese makes as little impression on the lacquered wooden dish from which they eat it, as does the heated saké. According to Professor H. W. Vogel, the simple black Japanese lacquered dish is proof against acid and alcohol, and serves an excellent purpose on this account in photo-chemistry.

It is by these properties, quite apart from the artistic adornment, that Japanese and Chinese lacquer wares may be recognised and distinguished from their European imitations, which are brought into the market from Holland, from Spa, Forbach, and other localities; for all these imitations are prepared from resinous varnishes which do not share in the properties of the Japanese.

All Japanese lacquer wares are called Nuri-mono, less frequently Uru-shi-saiku. Urushi signifies varnish—nuri, to spread over, especially with varnish; mono, the work; saiku, the wares or the manufacture. The lacquerers are divided into two general classes, viz., Nuri-mono-shi or Nushi-ya, and Makiye-shi. The first supply the groundwork and common lacquering. Those belonging to this class understand nothing of the business of the others, and only in exceptional cases employ precious metals for decoration. The Makiye-shi or lacquer painters stand higher. They understand also all the work of the Nuri-mono-shi, but are employed mostly with the decoration of the primed lacquer ware, especially with

[1] "Japanese lacquer is not like our copal varnish, an artificial mixture of resin, fatty oils, and turpentine, but in reality a ready-made product of nature." —Wagener.

the representation of pictures and designs in gold and silver dust. They are real artists, who wield their small brush with great firmness and skill, and not only work according to patterns, but often develop admirable creative power in designing.

Besides these two, there are or were still other classes of specialists, *e.g.*, Ao-gai-shi or mother-of-pearl inlayers, and the Saya-shi or sword-sheath lacquerers.

There is no longer any secret in the Japanese art of lacquer-work, although even in modern times the contrary has been asserted. Every one who will take the time, and bring to it the necessary previous knowledge, can study in Japan, as I myself did, the manner of obtaining and preparing the raw material. A real, expert study is indeed necessary, and as but few have hitherto had time and opportunity for this, and many have repeated without understanding what they have gained from incompetent Japanese sources, their reports are always full of erroneous assertions.

For these reasons, and because this treatise is almost exclusively the outcome of personal studies made on the spot and continued later in Europe, a complete statement of the literature of the subject seems unnecessary here. I will indicate only the most valuable works bearing upon it, remarking upon a part of them in passing.

1. "Mémoire sur la vernis de la Chine." By Father d'Incarville, Jesuit and Correspondent of the Académie. This appeared in "Mémoirs de Mathematique et de Physique, présentés à l'Académie Royale des Sciences, par divers Savans, et lûs dans ses Assemblées." Vol. iii. pp. 117–142. Paris, 1760.

A free German translation of this may be found in the Supplement to Heidemann: "M. Watin's Kunst des Staffiermalers, Vergolders, Lackierers, und Farbenfabrikanten (in 'Neuer Schauplatz der Künste und Handwerke'). Ilmenau, 1824."

In the first sentence of this still readable article, the author states that the lacquer of China is not a composition, but a gum or resin that exudes from the lac tree. Much of what is said about the manner of obtaining the lac, and its use, applies to Japan also, and is as true to-day as then. It is not to be wondered that there are some errors also, as, *e.g.*, when d'Incarville calls tea oil a drying substance, and gives it a place beside black Japanese lac, with burned hartshorn. Nevertheless, the article remains instructive and interesting, because in more than one place he gives expression to the superiority of the Japanese as perceived by the Chinese themselves.

2. Wagener, Dr. G.: "Japanischer Lack. Dinglers Polytechnisches Journal." Band 218, p. 361. 1875. This small work is the result of thorough observation and sound judgment, as is everything which this scientific and cultivated author has written concerning Japan.

3. Maëda: "Les Laques du Japon. Revue scientifique." 2me Série. Vol. vii. pp. 117–128. Paris, 1878.

4. Rein: "Das Japanische Kunstgewerbe. Oesterr. Monatsschrift für den Orient." Vienna, 1882. Nos. 4 and 5.[1]

5. Quin, J. J.: "Report by Her Majesty's Acting Consulate at Hakodati, on the Lacquer Industry of Japan." London, 1882.[2]

6. H. Yoshida: "On Urushi Lacquer. Journal Chem. Soc." 1883, p. 472 ff.

7. O. Korschelt and H. Yoshida. "The Chemistry of Japanese Lacquer. Transact. As. Soc. Japan." XII. pp. 182–220. While my limited chemical aids in Japan made it possible for me to make only a qualitative investigation of the raw lac, the authors of this very interesting article have succeeded in throwing light upon the constitution of its several elements. Korschelt particularly has pointed out its most important constituent—lac-acid, and thoroughly investigated its properties, besides tracing several interesting phenomena in its relation to the lacquer process, and making corresponding statements. Wherein I differ from his conclusions, I have given my own views in the place where such difference occurs.

[1] I spent the first five months of the year 1874, and of my stay in Japan, in Tôkio, chiefly in the study of lacquer work. After I had set up a chemical laboratory in the German Legation, I engaged two experienced and very competent lacquerers, one of whom, named Kisaburo, was a thorough artist, and arranged a workshop under their directions. My principal purpose was to become acquainted with the art of lacquering, and all the utensils and materials used in the work. In order to accomplish this, and at the same time to secure for the Royal Museum of Industrial Art in Berlin an instructive collection of samples, I ordered from a joiner one hundred tablets of Hi-no-ki wood (*Retinispora obtusa*), each 20 centimeters long by 13 centimeters broad. I kept a journal giving account of all the work, which I myself also participated in, and I also investigated all materials employed. When the collection was finished I sent it with a report to His Excellency the Prussian Minister of Trade and Industry, in Berlin. That report forms the foundation of this treatise. In order to complete it, and to learn more of the cultivation and value of the lac tree in the interior of the country, and the other branches of industry, I started upon my travels. The result of this journey was a report concerning the cultivation of the tree, the extraction of the raw lac, and of the vegetable tallow, after I had visited all the great centres of this cultivation, as well as nearly every place where important lacquer work was carried on, and had obtained the most truly scientific information regarding all. The succeeding pages cover the ground of my investigations as briefly as practicable, and treat also of the collection in the Royal Industrial Art Museum in Berlin, which in the nature of its origin and its instructive value may be truly said to stand alone.

[2] In Balfour's Cyclopædia of India, of 1873, there is this statement: "The manner of preparing the varnish, and the mode of applying it, is and is likely to remain a secret." Sir Joseph Hooker of Kew, in his report for 1882, quotes this, and concludes that Quin, consul in Hakodate, had learned the secret. Both these gentlemen appear to have as little knowledge of the above quoted works of Father d'Incarville and Dr. Wagener as of my own study of lacquer work in Japan.

Method of Obtaining the Raw Varnish, and its Properties.

The material of the industry now treated is an emulsion, the sap of the lac tree or Urushi-no-ki (*Rhus vernicifera*, D. C.), cultivated in China and Japan. The character of this species of sumach, its variety, and the distribution of its culture in Japan, also its introduction into Germany, have already been discussed on pp. 158–160. It has been especially noted also that the chief districts of lac cultivation lie in Northern Hondo, between the 37th and 39th parallels.[1]

About three-fourths of all raw lac is obtained north of the 36th parallel. The inland provinces and former Daimiô territories of Aidzu, Yonezawa, Yamagata, and Nambu, and lying nearer the Japan Sea, parts of the provinces of Echizen (*e.g.*, Ochiyama, not far from Fukui), Echigo (neighbourhood of Murakami, Nagaoka, and others), Ugo (Akita, in the district of the Tochima-gawa and Noshiro-gawa), and Mutzu (*e.g.*, at Hirosaki), are distinguished above all others for their extensive plantations of the lacquer tree. The lac of the young trees in the vicinity of Yoshino in Yamato is particularly estimated.

The extraction of the sumach lac has much similarity to the manner of obtaining manna from the trunks of Fraxinus Ornus in Sicily.[2] It is done by making a horizontal slit upon the tree (girdle cutting), and can be undertaken the whole summer through, from April to the end of October. The lac taken in spring is the least valuable, because it is very watery. The autumn product is much thicker, but also granulous and slow in exudation. The best time for the lac harvest is midsummer, as then the quantity and quality of the material fulfil best the demands. The sap, however, never flows from the incision so easily and plentifully that it can be caught in vessels, as has been several times asserted.

Lac extraction begins commonly when the tree is from nine to ten years old, and only in exceptional cases four to five years

[1] I add to the foregoing only this, that the tree in the Botanical Garden at Frankfort-on-the-Maine, nine years' old, at the end of its last vegetation-period, had reached a height of 6½ meters and a trunk-circumference of 48 cm., but as yet has never blossomed. On the other hand 19 smaller specimens, among which only one female tree was found, blossomed in June last year. Owing to the unfavourable weather of the autumn, their abundant fruits did not become fully ripe, but attained their full size and had deposited fat in the mesocarp.

Professor Wallach did me the kindness to allow his pupil, W. Sundheim, in the chemical laboratory of the University of Bonn, to undertake the extraction and estimate of the gravity of the fruit. The result was as follows: From 100 fruits dried in the open air, and 6·151 grammes in weight, there was extracted of fat, 0·60625 grammes; shell (epidermis and mesocarp), 2·36 grammes; kernel (putamen and embryo), 4·15 grammes. The fat formed 29·37 per cent. of the weight of the shell, and 10·23 per cent. of the weight of the entire fruit. The colouring matter extracted is not brought into the calculation.

[2] See Flückiger, "Pharmakognosie," 2 Auf., p. 21.

earlier, as in the district of Yoshino, province of Yamato. The two most important instruments used in obtaining it, are the Kaki-gama or scratching sickle (Plate III. fig. 10), a thin iron plate bent like a fish-hook, with its U-shaped end tempered and sharpened like a knife on the concave side, corresponding to the lancet of our foresters; and the Natsu-bera or summer spatula (Plate III., fig. 11), a flat iron spoon with a short, bent-over point. The first is used to cut the tree, but the Natsu-bera for scraping out the channels when full of lac, and lifting it into the Gô or small wooden or bamboo pail. In the case of old trees with a thick, rugged bark, this must first be cleared away and the trunk made smooth before the Kaki-gama can be used. This bark scraping is effected by the Kawa-muki or bark peeler, a long, somewhat sickle-shaped, bent knife. The straight knife or Hôchô (Plate III., fig. 1), and the Ye-guri, punch or gouge (Plate III., fig. 2), are also occasionally used by the lac-tapster. If he is sensitive to the poisonous vapour of the sap, he protects his hands by Te-bukuro or mittens.

Almost all the workmen engaged in extracting the lac come from the vicinity of Fukui in the province of Echizen. They number some fifteen or sixteen hundred. They go out into the several lac-districts in spring, mostly toward the north, where they are employed by the lac-dealers, who buy the trees from the peasants and point them out to their workmen, usually 1,000 young trees to each. Where the trees are older, from 600 to 800 will keep a Shôkunin busy for the entire summer. Ten years ago the average price of 100 trees was from 30 to 36 yen, but it is now almost doubled, owing to the greater demand for raw lac, and its increased price.

When the lac-tapster has made all his preparations and cleared his trees of bark, he takes the Kaki-gama, and with a quick stroke in a horizontal direction makes an incision through the rind and bast about two millimeters broad, on the lower part of the trunk. He passes the hook of the knife through this girdle-cutting, in order to remove any bits of bark which may have fallen in, and then a span (15 to 20 cm.) higher, on the opposite side, makes a second and a third gash the same distance apart, then afresh on the other side in six to ten places, quickly following, as far as he can reach. I have seen a practised Urushi-shôkunin make an incision each second. Then he goes to another tree and does the same. When he has cut ten or fifteen trees, he returns to the first and collects the raw lac or Ki-urushi in the same order. It is a greyish white thick emulsion, which becomes first yellowish brown and soon after black, on exposure to the air. It fills the gash but does not usually run over. It is taken out with the point of the Natsu-bera and then scraped off over the edge of the little pail (Gô) which the workman carries in his left hand.

When he has finished this work, he goes to another group of trees, and performs the same operation, and so on. After four days he returns to the first trees and makes this time new incisions parallel to the others, and about two millimeters lower, then to the others in the same way, scraping out the exudations from the new series as he did in the first instance. As this operation is repeated with the same interval some fifteen or twenty times, it will be seen that the work of the lac-tapster occupies not less than 60 to 80, and often 100 days before it is finished. If the tree is to be sacrificed to the lac-extraction, then he makes incisions in all parts of the tree not yet cut, even the branches, but at greater distances. If, however, it is to be kept for further yield, and especially for wax-extraction, the treatment is more careful, and the incisions more sparing. In the first case, where the tree is made to yield its utmost, it is customary to cut down the branches after the leaves have fallen, and to bind the thicker parts together in fagots of one meter length, and to put them with the tops in warm water. The parts of the branches which protrude out of the water are then scratched, the lac extracted, the fagots are turned and the process repeated on the other side. The sap can be made to circulate anew, not only in water but by the heat of fire. But the lac so extracted, Se-shime, or Shime-urushi, is considered the poorest of its kind, and is used only in groundwork. The best Ki-urushi comes from the lower part of the tree and flows best during the hottest part of the year. It is of an even, viscid constituency and a tan-brown colour. The poorer qualities are generally darker, and not homogeneous, somewhat granulated and almost jelly-like in thickness. These are obtained from the branches and higher parts of the trunk.

One lac tree yields on the average under exhaustive treatment, to which the tree of course is sacrificed, only 1·5 to 3 gô, or 53·50 ccm. of raw lac, corresponding to about 27 to 54 grammes, as its specific gravity is a little above that of water.[1]

According to Dallas,[2] in 1874 the lac yield of Okitama-ken (district of Yonezawa in Uzen), one of the principal districts of lac-culture, was 3,608 kin, or Japanese pounds (à 592·593 gr.)=2,165 kilogrammes. Besides this there was manufactured from the fat of the fruit 62,598 kin=37,559 kilogrammes of Rô-soku or candles. If the average yield be 40 grammes raw lac per tree, 60,140 trees must be sacrificed to gain these 2,165 kilogrammes.

Ki-urushi is always packed in Taru (tubs) of the size and form of our common wooden pails. They are made of Sugi (*Cryptomeria japoncia*), bound with bamboo hoops and covered with a

[1] W. Williams, in "The Middle Kingdom," says that in China, each 1,000 trees are supposed to yield an average of only 20 lbs. of lac. This makes (one pound avoirdupois=453·6 grammes) in all 9,072 grammes, or only nine grammes per tree.

[2] "Notes collected in the Okitama-ken." Trans. As. Soc. of Japan, 1875, p. 118.

round cover like the bottom of the tub. Before they are closed up, two sheets of strong, oiled bast paper are laid on the lac, large enough to overhang the rim, between it and the cover. As soon as the cover is fastened on, the paper is bound over the edge of the tub from 4 to 6 cm., and straw rope is then wound around tight from nine to twelve times. The sealing is thus so perfect that during transportation, even if upset or laid in a horizontal position, the tub is safe from leakage or overflow.

I was told in Yonezawa that such a tub holds usually $8\frac{1}{2}$ Kuwanme (1 Kauwnme=1000 Me=3·371 kg.) or 29·848 kilogrammes. Quin, however, states in his above-mentioned work, that it contains about four English gallons, or a round 18 kilogrammes, which seems to me also more probable. From this it appears that the above-named product of Ki-urushi in Yonazawa-ken, 2,165 kilogrammes, could have been carried in 120 Taru. The quantity of Ki-urushi yielded by the whole country varies apparently between 60,000 and 100,000 kin, corresponding to 35,556–59,259 kilogramms, or from 1,975–3,292 Taru or tubs at 18 kilogrammes each.

In 1875, twenty Momme or 75 grammes of Ki-urushi were bought for 2 Shu (about sixpence); in 1882, however, only 8·75 Momme= 32·8 gramms. The price also was advanced to about fifteen shillings the kilogramme, against seven shillings in 1875.[1]

[1] According to official statements, which however include very many undoubtedly erroneous data, the raw lac production of Japan for the years 1876–77–78, was 60,656 kin, 99,267 kin, and 66,639 kin, respectively, in value 37,742 yen, 49,800 yen, and 49,179 yen. In 1878, the yield was estimated in Fu, and Ken, as follows:—

Kiôto-fu	756 kin.	Yamagata-ken	4,624 kin.
Aitchi-ken	2,210 „	Akita-ken	2,771 „
Miye-ken	53 „	Fukui-ken	2,697 „
Yamanashi-ken	429 „	Ishikawa-ken	7,785 „
Kanagawa-ken	1,309 „	Niigata-ken	3,887 „
Gifu-ken	5,014 „	Shimane-ken	205 „
Nagano-ken	8,656 „	Okayama-ken	225 „
Gumba-ken	458 „	Hiroshima-ken	1,516 „
Tochigi-ken	3,014 „	Wakayama-ken	1,295 „
Fukushima-ken	3,614 „	Kôchi-ken	3,504 „
Miyagi-ken	562 „	Yehime-ken	1,750 „
Iwate-ken	8,801 „	Fukuoka-ken	600 „

in all 65,735 kin. Apart from the fact that this sum does not agree with the total amount given above, many of the single items have such a mark of arbitrariness, that it will not do to rely upon these statements. They make Kôchi and Yehime-ken, for instance, or the island of Shikoku, a very large lac-producer, while the cultivation of the lac tree is limited almost entirely to the eastern part, the province of Awa and the bordering Sanuki. I did not see lac trees anywhere in Tosa and Iyo, nor hear of their culture anywhere in the districts I did not visit. The provinces of Owari, Mino and Shinano (Aichi-Gifu and Nagato-ken), appear here also as large producers, while I sought lac trees in vain in all three, and as in Tôkio, was referred at every inquiry to the north, and particularly to Aidzu, which had long been celebrated for its wax, but as a lac-producer was far behind the provinces of Echigo and Uzen.

According to the reports of Quin, the yearly extract of raw lac in Japan is

Ki-urushi or raw lac, like the varieties of lac prepared from it, is kept in wooden vessels (tubs or flat round boxes), and protected carefully from light and dust. It cannot be used by the lacquerer without further preparation, but must first go through various processes of purifying and transformation, the first of which consists in freeing it from the mechanically introduced bits of bark and wood. To effect this, it is pressed through cotton cloth, and then is called Ki-sho-mi, *i.e.*, raw lac free from foreign substances.

Before I go farther, I will give the results of my own, and particularly of Korschelt's, investigation of this substance. Ki-shô-mi, or purified raw lac, is a grey to tan-brown, syrupy, very sticky liquid of varied consistency and a specific gravity but little greater than that of water. Korschelt estimated this at 1·0020–1·0379, with which my own observations agree very well. A peculiar, sweetish smell is especially noticeable in it, if it has been long in a closed vessel. Under a powerful microscope a brownish mass scattered with small globules of two sorts may be discovered, viz., a very numerous small dark brown, and a more sparsely scattered larger light-coloured sort. On adding water the latter disappear, while pure alcohol dissolves only the first kind. Alcohol, like all solvents of resin,—ether, chloroform, bi-sulphide of carbon, benzine,—dissolves when cold, but much easier when moderately warmed, a large quantity (between 60 and 80 per cent.) of raw lac, while water has scarcely any influence, save to take up a small percentage of the raw lac, after long shaking, which shows that this lacquer is of a gummy resinous character. The constituents are as follows:

1. A very small proportion of volatile acid. This disappears very soon in ordinary temperature and the drying of the lacquer-paint, but more rapidly when the lacquer is distilled with water. I attribute the poisonous properties of raw lac, and the lacquer-disease, to this not yet sufficiently understood substance.

2. Water in varying quantities, from 10 to 34 per cent., according to whether the raw lac is obtained from young or old trees, trunks or branches, in spring, summer, or autumn. It can be expelled by stirring in the sun or over a slow fire, but especially by distillation in a water-bath.

3. A nitrogenous substance which Korschelt considers as albumen. Its quantity varies from 1·7 to 3·5 per cent.

4. Gum, which in all essential characteristics seems to be the

from 30,000 to 35,000 tubs. If he is followed in his estimate of four gallons to the tub, or a weight of 18 kilogrammes, we have the enormous quantity of 540,000 to 630,000 kilogrammes, or more than five or six times the heavy yield of 1877. There can be no doubt that this statement is erroneous. This is seen also in Quin's own words, that every year about 1,500 lac tapsters are sent out into the several districts of the country, and that each one can collect about 4½ Taru or tubs of lac.

Given now, the maximum of collection to these 1,500 persons, and we have $1{,}500 \times 4\frac{1}{2} = 6{,}750$ tubs, and to each tub 18 kilogrammes, the total production amounts to only 121,500 kilogrammes.

same as gum Arabic, and amounts to from 3 to 6·5 per cent. of the whole.

5. Lac-acid or Urushi-acid is the predominant and most important ingredient. Its quantity is usually between 60 and 80 per cent. of the total weight, and in the best lac of Yoshino amounts to 85 per cent. Analyses made by Korschelt from seven different lac-samples, give the following result :

Constituents of the Raw Lac.	1 Yoshino, Prov. Yamato.	2 Hottamura, Prov. Hidachi.	3 Southern Sagami.	4 Northern Echigo.	5 Hachiôji, Prov. Sagami.	6 Unknown origin, bought in Tôkio.	7 The same.
Lac Acid	85·15	64·62	65·83	66·92	80·00	64·07	58·24
Gum	3·15	5·56	5·02	4·75	4·69	6·05	6·32
Nitrogenous Substance	2·28	2·10	2·01	1·72	3·31	3·43	2·27
Oil	?	0·09	0·06	0·06	?	0·23	?
Water	9·42	27·63	24·08	26·55	12·00	26·22	33·17

The small quantity of oil found in several of the foregoing analyses is not an original property of the lac itself, but came in the process of obtaining it from the tree, as the tapster oils his knife and spatula with E-no-abura (Perilla oil) in order to prevent the lac adhering to the iron.

The principal and most important constituent of the lac is the already-mentioned lac- or urushi-acid, $C_{14} H_{18} O_2$ which is distinguished by the microscope as little brown globules, and extracted best in pure, warm alcohol. This formula ascertained by Korschelt in an elementary analysis, is distinguished from that of the Borneo camphor by 6 parts less of carbon.

Lac-acid shares with resinous acids its solubility in alcohol, ether, chloroform and other liquids, and in many cases the relation to metallic bases also, but is much more active, inasmuch as its alcoholic solution enables it to decompose nitrates and chlorates. The reaction in sugar of lead solution is peculiar. It forms in contact with lac-acid at once a grey, flaky precipitate of lac-acid lead. Most interesting of all, however, is the conversion of the lac-acid into an exceedingly steady neutral substance, oxylac-acid, whose properties will be discussed further on under the lacquer process.

The Ki-shô-mi or purified lac, according to my observations, when closely mixed with water added to it, takes it up gradually and completely, especially if it previously contained proportionably but little water. It loses in this way its fluidity, however, and becomes of a jelly-like thickness, which when painted on wood or other groundwork, dries very quickly. On the other hand, besides heat, camphor or Shônô is the only material for thinning the lac known to the Japanese from earlier times and is the only one still used. It is taken in its usual granulated and crystalline condition, pulverized and mixed with the lac by the spatula and thus made liquid. Camphor oil, although it answers the same purpose very well, as my experiments with it in the presence of my Japanese lacquerers proved, appears never to be used by them.

Among the properties remaining to be noted in the material under treatment are these ; that it turns to black on exposure to the light, dries easily in a damp atmosphere in ordinary temperature, and that its evaporation produces a kind of poison which is the cause of the lac-disease.

The drying of fresh lacquer-painting differs from that of our resinous varnishes in that it is not promoted by artificial heat, but is best accomplished in a damp atmosphere, as free as possible from dust, in the ordinary temperature, between 10° and 25° C. or at most 30° C. The direct rays of the sun are injurious, because the heat is uneven, and the stronger it is the more it hinders drying. The lacquerer fulfils the necessary conditions by choosing a dark room (chest, closet or chamber) in the most quiet retired place, and provides against the insufficient moisture of the atmosphere by some artificial means.

In a small shop, where a roomy chest with some boards inside resting on cross-pieces suffices for the work, the boards, the inner walls and the cover are all washed with cold water before the freshly painted lacquer wares are placed in it to dry. In other cases a large cupboard is treated the same way, for the same purpose. If it is necessary to use an entire room, it is customary to hang wet cloths on the walls, and to set vessels of water about in order that the necessary moisture of the atmosphere may be gained through evaporation.

Father d'Incarville says on page 127 of his before-cited work : "Ici à Peking, ou l'air est extrêmement sec, pour sécher le vernis, il faut nécessairement l'exposer dans un endroit humide, entouré de natte, que l'on arrosera d'eau fraiche ; autrement le vernis ne sécheroit pas ; si c'est une pièce mise en place, qu'on ne puisse détacher, ils sont obligés de l'entourer ainsi de linges mouilliés."[1]

The lac-acid extracted by means of pure alcohol does not possess this peculiarity of drying, as I learned in 1874, and as the numerous experiments of Korschelt have shown later. It hardens only when it is mixed with the albumen and water, as in lac. The mixture, however, loses this property when heated over 60° C., *i.e.*, above the temperature in which albumen coagulates.

[1] In this connection, his countryman Watin, in his book on the Art of Decorators, Gilders and Lacquerers, says, "This observation seems contrary to all experience."

Korschelt has pointed out further that the albumen present in raw lac acts in drying as a ferment upon the lac-acid, and that the hardening of the lacquer-paint is due to a process of oxydising, by which the lac-acid taking up oxygen is converted into oxylac-acid, according to the formula $C_{14} H_{18} O_2 + O = C_{14} H_{18} O_3$. When Korschelt investigated still further this oxy-urushic acid which he obtained in the form of a brown powder, he found that it is entirely insoluble in all the solvents of lac-acid, and that both potash and soda lye, ammonia in all degrees of concentration and of every temperature, and most acids, strong saltpetre excepted, have no effect upon it. It is therefore evident that the remarkable resistance of dry Japanese lacquer-work to these influences is due to the presence of this oxylac-acid.

Korschelt's investigations and opinions do not favour the accepted theory that in the drying of lacquer-paint water is used for making hydrates. But this leaves me without an explanation of the thickening of the raw-lac to which I have alluded before, especially of the Se-shime-urushi, when water is added,—a process any one may observe, and in which a separation of the hydrogen is not perceptible.

In conclusion, I will mention the lacquer-poisoning or Urushi-kaburé as the Japanese call it, to which I have already referred briefly on p. 343. It is a peculiar, not very painful, and not at all fatal, but always very disagreeable disease, always attacking one new to the work, whether he be lac-tapster, dealer, or lacquerer. It appears in a mild reddening and swelling of the back of the hands, the face, eyelids, ears, the region of the navel and lower parts of the body, especially the scrotum. In all these parts great heat is felt and violent itching and burning, causing many sleepless nights. In two or three days the crisis is reached, and the swelling immediately subsides. In severe cases, small festering boils form also. This lacquer disease, admirably described by Father d'Incarville on page 119 of his work, to which I have now frequently alluded, is not only caused by direct handling of the lac, but by its evaporation chiefly, especially that of the sharp Se-shime, to which I owed my own illness.

The poison, however, is a volatile substance, and has nothing to do with the lac-acid and its higher oxydation, as Korschelt believed. If the poisonous property disappears in the drying of the paint, this amounts to nothing save that the volatile poison fully escapes in this manner. A considerable part of it is driven off in the preparation of the several kinds of lacquer, and by stirring in open vessels. For this reason, the lacquers mixed with colours are regarded far less dangerous than raw lac and its direct derivatives. When such lac has been for a long time shut up in a closed box or tub, the experienced workman turns away his face when the vessel is opened that he may not inhale the accumulated vapour. This is noted by d'Incarville also in the following: " Il faut prendre garde, en couvrant et découvrant les vases qui contiennent le vernis, de s'exposer à sa vapeur ; on tourne la tête pour l'éviter ; sans cette attention l'on courroit risque de gagner les clous de vernis."

Preparation of the Raw Lac for the Lacquerer.

Ki-shô-mi, the raw lac (Ki-urushi) purified from foreign substances, is ground for some time in a shallow wooden tub, to crush its grain and give it a more uniform liquidity. It is then pressed through cotton cloth (wata-goshi) or hemp-linen (nuno-goshi), In this way the several varieties of Se-shime[1] which appear in the price list are obtained, and are much used not only for groundwork, but also in the final (polishing) work upon the lacquer wares. Thus Se-shime is nothing else but a purified, filtered and evenly flowing raw lac.

In order to describe the remaining varieties of lacquer, it will be necessary to follow the mechanical purification in its removal of a considerable part of the water admixture. This is done by evaporation in the sun, or by mild heat over a coal fire. The Ki-shô-mi, or Se-shime, is poured into shallow pans, which have an average diameter of 0·5 to 1 meter, and walls 2 to 4 centimeters thick, and is stirred constantly with a flat paddle. In the northern cities specially engaged in the lacquer industry (Niigata, Wakamatsu, Yonezawa, Hojiri, etc.), these pans are made of cross sections of Tochi (*Æsculus turbinata*, Bl.), and in Tôkio and other southern cities, out of such cuttings from the trunks of the Keaki (*Zelkowa Keaki*, Sieb.). The lac is heated in the former over a moderate coal fire, in the latter in the sun, the pan being inclined against a wall, so that the contents, as they are stirred may have the full benefit of the sun's rays. The work takes usually a few hours, the quantity of water is noticeably reduced, and the so-treated Kurome-urushi becomes a syrupy, greyish brown liquid like Se-shime. In the three principal cities of the country (Tôkio, Kiôto and Ôsaka) this preparation and that of the hereinafter named varieties is made by a particular guild of lacquer dealers, which ten years ago numbered sixteen members. These dealers, or Urushi-ya, recognise in their price list 16 to 20 varieties of lacquer. The workmen of other cities informed me that this was an unnecessary division, and maintained that for all practical necessities, 5 to 6 varieties would suffice. The Urushi-ya is evidently a medium which furnishes a better though higher-priced material to the lacquerer than that which he gets by preparing it for himself, as is done in the cities where a more limited lacquer industry is carried on.

[1] The word Se-shime is not to be taken here in the narrow sense of lac obtained from the branches of the tree, but is derived from *seshimeru* (to make firm and durable), and refers to its use in groundwork. Only a small part of this Se-shime-urushi is branch lac.

The differences between the several varieties in the price list are certainly small. A number of them are not found among dealers in Tôkio at all, as, for example, the Saya-hana, whose significance departed as the old swords and their sheaths lost their place in the common esteem. At all events, Se-shime, Nashiji, Shu-urushi, Rô-iro, Nuritate and Hana-urushi are the varieties which are most valued and used in the best workmanship.

Urushi Nedan Dzuke, or Lac Price List of Tôkio, for the years 1875 *and* 1882, *combined and arranged in order.*

I. According to the number of Momme (a weight of 3·75 gr.), which may be bought for 2 shu, or 50 pfeninge. II. According to the price for 1 kilogramme in marks.	I. Number of Momme which one gets for 2 shu.		II. Price of a kilogramme in marks.	
	1875.	1882.	1875.	1882.
1. Nashiji, *i.e.* pear ground, greyish brown lacquer	7	4·5	20·95	29·63
2. Rô-iro, *i.e.* wax colour, best black lustre lacquer	9	5·25	16·30	25·39
3. Shu-urushi, *i.e.* cinnabar lacquer . .	12	6·25	12·22	21·33
4. Nuritate, finishing lacquer	12	6·166	12·22	21·62
5. Saya-hana, sword sheaths, flower lacquer	12	—	12·22	—
6. Hako-shita, *i.e.* groundwork for boxes	12	6·125	12·22	21·77
7. Shun-kei, yellowish lacquer	15	7·375	9·78	18·07
8. Jô-tame, best light brown lacquer . .	15	7·375	9·78	18·07
9. Jô-hana, best flower lacquer	15	7·0	9·78	19·04
10. Jo-naka, Jo-chiu-hana, or Naka-nuri, for use between the layers	17·5	7·875	8·04	16·37
11. Yoshino, purified raw-lac, from Yoshino in Yamato	17·5	8·75	8·04	17·51
12. Jo-chiu-tame, light brown middle lacquer	17·5	—	8·04	—
13. Ki-shô-mi, purified raw lac	20·0	8·75	7·33	17·51
14. Chiu-hana, flower lacquer, 2nd quality	20·0	8·75	7·33	17·51
15. Wata-goshi-Se-shime, *i.e.* Seshime pressed through cotton	20·0	—	7·33	—
16. Men-goshi-Se-shime, *i.e.* S. pressed through cotton cloth	—	8·75	—	17·51
17. Nuno-goshi Se-shime, *i.e.* S. pressed through hemp-linen	22·0	9·375	6·67	14·22
18. Kuro-tame, black-brown lacquer . .	25·	10·625	5·87	12·55
19. Chiu-tame (Naka-tame) light brown middle lacquer, 2nd quality	25·	—	5·87	—
20. Nami-tame, ordinary light brown lacquer	32·5	14·375	4·52	9·27

This list shows that the several varieties of lacquer differ greatly in price, that even the least important are very costly, and that the price has increased remarkably of late years. If in spite of this, the common lacquer wares are sold at very low prices, it is to be explained by the fact that it takes but a very small quantity of this expensive material to paint over a large surface, and that the necessities and wages of the Japanese workmen are very small.

Nashi-ji and Shu-urushi, and the nearly related Shiyun-kei and Jô-tame, are classed together as Suki-urushi, *i.e.* transparent lacquer. They are free from iron admixture, are of a reddish yellow colour, and transparent in thin layers, and are used mainly in the final operations of the lacquerer. Nashi-ji gets its name "pear ground" from its use in a kind of surface decoration with coarse gold powder or its bronze substitute, which is said to be an imitation in colour of the Japanese pears. This most expensive of all lacquers contains 1 per cent. of Shiô, or gamboge, which is added in powder or concentrated solution to the Ki-shô-mi after it has been pressed through hemp-linen, either before or while it is being stirred in the sun. From 16 to 18 hours are necessary for the evaporation of the water, steady stirring, according to the degree of warmth and amount of moisture in the air.

The Nashi-ji is then pressed twice through the cotton filter, and can be used without any further process. Shiyun-kei is prepared in a similar way, but with less quantity of raw lac, and with an addition of Ye-no-abura (Perilla oil). Instead of gamboge, also plum juice (from the fruit of the Mume) is used, or the yellow extract of Kuchinashi, *i.e.* the fruit of Gardenia florida. Jô-tame is obtained by exactly the same process save that a thicker raw lac is used.

Shu-urushi, cinnabar lacquer, is a transparent variety, which is prepared like Nashi-ji from the best raw lac taken from the lower part of the trunk, at the hot Doyô (dog-days), but is distinguished from it by an addition of from 1 to 10 per cent. of Yegoma-no-abura. It is called cinnabar lacquer, because cinnabar is carefully and thoroughly rubbed into it, and it is used in producing this colour in painting. To produce very ordinary red colour, Beni-gara or colcothar is sometimes used.

Kuro-urushi is the collective name of all black lacquer, which is prepared by adding to the purified and filtered raw lac a solution of some salt of iron (green vitriol or acetous ferric oxyde) or Toshiro (iron filings water) and then expelling the water again by stirring. In the preparation of Ro-iro-urushi, or best black lustrous lacquer, a very good quality of purified raw lac is used, and to Wata or Nuno-goshi, Haguro, a solution of acetous protoxide of iron is added, and the whole is stirred in shallow pails or small tubs in the sun or over a moderate fire, till the water is fully evaporated. (This protoxide of iron is the material generally used by Japanese women for blacking the teeth. It is obtained by pouring rice beer or vinegar over iron nails or iron filings and keeping the solution for several days in a warm place.)

The quantity of iron solution added is determined by the colour. The iron contents vary from 0·5 to 2 per cent. When all the water is expelled, the Rô-iro-urushi is passed twice through cotton cloth, and is ready for use as a black lacquer, without further treatment.

Hana-urushi, flower lacquer, is also a black lacquer, like the preceding, and similarly prepared. It contains somewhat less iron, but has a slight addition of Yegoma-no-abura, while Haka-shita is prepared like Rô-iro without oil, but of a much poorer quality of raw lac. Saya-hana, Jô-hana, Jô-chiu-hana and Chiu-hana are several kinds of flower lacquer, as appears on the price list. Naka is a synonym of Chiu, meaning "between," and in the word Naka-urushi signifies a black lacquer of poorer quality which is employed generally to finish the groundwork. All these cheaper black lacquers, which are made from the poorer varieties of raw lac and used chiefly in groundwork, contain Yegoma-no-abura. In Nuritate, which must be classed with them, the oil amounts to 10 per cent. In the northern cities, where each lacquerer prepares all his lacquer materials for himself as he needs them, only one kind of black lacquer is made, and is designated simply as Kuro-urushi.

The different grades of chestnut brown, or Kuri-iro-urushi are made by mixing the black and cinnabar lacquers together. Gold-yellow or Kin-iro is made by genuine gold powder or its bronze substitute, and Gin-iro or silver white by means of silver dust. Kiwô-urushi, *i.e.* orpiment lacquer, is greenish yellow in colour, and is made by an admixture of the yellow powder of sulphide of arsenic with transparent lacquer. Awo-urushi or green lacquer is produced in a similar way, by mixing very thoroughly with transparent lacquer a green powder called Sei-shitsu (pronounced Sests').[1]

As this exhausts the number of Japanese lacquer colours, it appears that the lighter shades of colour, white, yellow, blue and red with their many shades and combinations, and the light green also, are wanting. The Japanese and Chinese have made many attempts to get them, and their failure is to be attributed to the peculiarity of the lacquer.

In conclusion, I add to this description of the several varieties of lacquer and their preparation, a list of other materials and utensils used by the Japanese lacquerer. Of colours and other decorative material there are: 1. Shu, cinnabar; 2. Kiwô, orpiment; 3. Ai, or indigo from Polygonum tinctorium; 4. Sei-

[1] I found to my surprise, in the analysis of this Sei-shitsu,—concerning which during my stay in Japan I could only obtain the explanation that it was "a kind of green colour," as Hepburn remarks in his dictionary,—that it is a mixture of Japanese indigo with orpiment. Later, when I procured the before-mentioned work of Father d'Incarville, his observation on page 137 astonished me; "Pour le vert, ils se servent d'orpiment qu'ils mêlent avec de l'indigo."

shitsu, a mixture of 2 and 3; 5. Beni-gara, red oxide of iron; 6. Beni, carthamin; 7. Shiô, gamboge; 8. Tonotsuchi, white lead; 9. Sumi, charcoal, particularly *a.* Matsu-no-sumi-no-ko, *i.e.* pulverized pine charcoal; *b.* Hô-no-ki-sumi, magnolia charcoal; *c.* Tsubaki-no-sumi, camelia charcoal; *d.* Rô-iro-dzumi, charcoal of Lagerströmia indica; 10. Aogai, mother of pearl of Haliotis and large species of Trochus; 11. several sorts of yellow and green gold dust (Yaki-gane and Koban); 12. Gin-pun, silver dust; 13. Kin-baku, genuine gold foil; 14. Gin-baku, silver foil; 15. Shari-kaganai, tin foil; 16. Shari-nashi-ji, tin dust.

There are used in groundwork: 1. Nuno, hemp canvas; 2. Kokuso, hemp bast or cotton wadding cut into small pieces; 3. Kami, bark paper; 4. Shônô, camphor; 5. Nikawa, animal glue; 6. Shibu, the astringent juice of unripe persimons (*Diospyros Kaki*); 7. Hai-dzumi, lamp black; 8. Ji-no-ko, finely pulverized brick dust; 9. To-no-ko, iron ochre powder; 10. To-ishi, whetstones of several kinds for grinding; 11. Hô-no-sumi, and other above-named charcoals for the same purpose; 12. Tsuno-ko, pulverized burnt hartshorn for polishing after lacquering; 13. Tane-abura, for the same purpose, and for cleaning the pencils and brushes; 14. Nori, paste.

The utensils for lacquering are simple and in general well adapted to the work. Illustrations of those most used may be seen in Plates III. and IV. The originals are in the Royal Industrial Art Museum in Berlin. The following are used in groundwork: 1. Hôchô, a straight, sharp kitchen knife (Plate III. 1); 2. Ko-gatana, a straight, stiff, but smaller pocket-knife carried in a case; 3. Ye-guri, a hollow chisel or gouge (III. 2); 4. Hasami, a pair of shears resembling our wool-shears (III. 3); 5. Hera, a wooden spatula (III. 4, 5); 6. Take-bera, a pointed bamboo spatula (III. 6); 7. Hake, a flat brush of human hair (III. 7); 8. Unoke-hake, a flat brush of rabbit's hair (IV. 3); 9. Abu, a rack for drying the brushes; 10. Jô-ban, a little wooden box to hold the tools, on whose projecting cover the different groundworks are prepared, the brushes cleaned and the spatulas sharpened. These two instruments are the most important. The spatulas are made out of Hi-no-ki (*Retinispora obtusa*) or some kindred variety of pine. They have a pointed, rounded-off handle, and an elastic, flexible plate, thinner and wider in front, growing broader to the end, which is from 1 to 3 fingers broad, and cut off diagonally. The flat brushes also, or Hake, are of different breadth according to the purpose which they serve. A strand of long, black human hair, glued tightly together, is laid along the length of and between two thin wooden plates, which are glued together and bound on the long sides by bands, the hair projecting from 1 to 2 millimeters. When the hair has been used till it is worn away, the wood is sharpened off like a lead pencil, and the hair carefully and evenly trimmed off. The colours and other materials that are to be used in lacquering are crushed on a board or the cover of the Jô-ban, and then mixed thoroughly into the lacquer with the spatula. This also takes the place of the pestle in the pulverizing mortar. With it is carried the cement and jelly-like materials for the groundwork, the brush taking up all the lacquer varnishes.

In the delicate final work, several different Fude or round brushes (IV. 6-11) are used, made from rat, rabbit and deer hair, in bamboo handles with bamboo protectors, as some of the illustrations show, which can be pushed down over the brush when it has been cleaned after using. The Fude-tate is a brush carrier, for the preservation of the foregoing (Fig. 2). For laying on the fine jelly-like colours, a little palette of tortoise-shell or buffalo-horn, called Tsuno-ban (III. 8), is used, being pushed over the thumb of the left hand. Several little Nashi-ji-tsutsu, dust sieves, or Tsutsu-furui, pipe-sieves, are used, according to the size of the surface, freshly painted with lacquer, which is to be strewn evenly with some kind of powder. These are made by cutting quills or bamboo canes diagonally across, and pasting a porous fabric of silk or other stuff over the openings. See Plate IV. Fig. 1. A small stick with a Tai-ki or little fish-tooth (from Serranus marginalis, the Tai) on the end is shown by Plate IV. Fig. 2, and used for polishing bent corners and other furrows into which the sharpened charcoal will not reach. Plate IV. Fig. 3 shows a Yanagi-yôji or willow-wood brush, universally used by the Japanese as a tooth-brush. It serves to brush away superfluous powder, while the pointed end of the handle, or a specially pointed stick, as the Hirame-fude, is used for picking up and laying on of gold foil or mother-of-pearl leaves on the fresh layer of lacquer. Kebo (IV. 5) is the long-haired brush of deer or horse-hair which is used to brush off any dust that may have settled on the lacquered article. Plate III. Fig. 9, represents the Saji, or spoon used to put the gold and silver dust into the pipe sieve. The back can be used also instead of a spatula for laying single layers of groundwork on concave surfaces.

Wood (Ki) stands first among the materials from which articles to be lacquered are made. Wood of the pine tribe is used chiefly, and Hino-ki, or the wood of Retinispora obtusa, is considered far the best, as it is white, free from knots, and not very resinous. Sawara (*Retinispora pisifera*), and Hiba (*Thujopsis dolabrata*) stand second, and then follow firs, pines, and cryptomeria. The wood of the Hô-no-ki (*Magnolia hypoleuca*) excels in fineness of grain and elasticity. The thin side-walls of the popular light oval bread-baskets, for example, made principally in Shidzuoka and Niigata, are of this wood. The light wood of the Kiri, too (*Paulownia imperialis*), is much used for lacquer wares. The wood of several other foliaceous trees distinguished for toughness and firmness, like Keyaki (*Zelkowa Keaki*), Sakura (*Prunus pseudo-cerasus*) and Buna (*Fagus Sieboldi*) are turned by the lathe into vessels and then lacquered. In Wakamatsu and Yonezawa, many of the Wan, or soup bowls of the Japanese, are made out of Buna. They are heavier and less durable than those made from Keaki or Katsura (*Cercidiphyllum japonicum*). Only the wood of the camphor laurel is entirely unsuitable for lacquering on account of its exuding camphor gum and its previously mentioned property of thinning the varnish.

Other articles made from stiff paper pulp, *e.g.*, from Ikkambari, a sort of papier maché, and Kami-kawa or paper leather, are lacquered, also some from Tsuno, horn, and Bekko, tortoise-shell, from bamboo cane or Take, whose outer skin must first be taken off, from Tetsu, iron and Aka-gane, copper, the various unglazed clay wares, especially porcelain (in Nagasaki and Nagoya chiefly), also Banko-yaki and common earthenware (in Ise and Nagoya).

The following important rules are observed by the lacquerer :

1. Every coat must be laid on evenly and then gone over crosswise with the spatula or brush, first in one direction and then afterwards in the other.

2. No new coat must be put on before the last one is dry.

3. It can be best determined when a smooth surface is dry by the condensation and disappearance of moisture breathed upon it.

4. Only the groundwork can be dried in the open air or direct sunlight, and then only when the coating contains very little or no lac admixture.

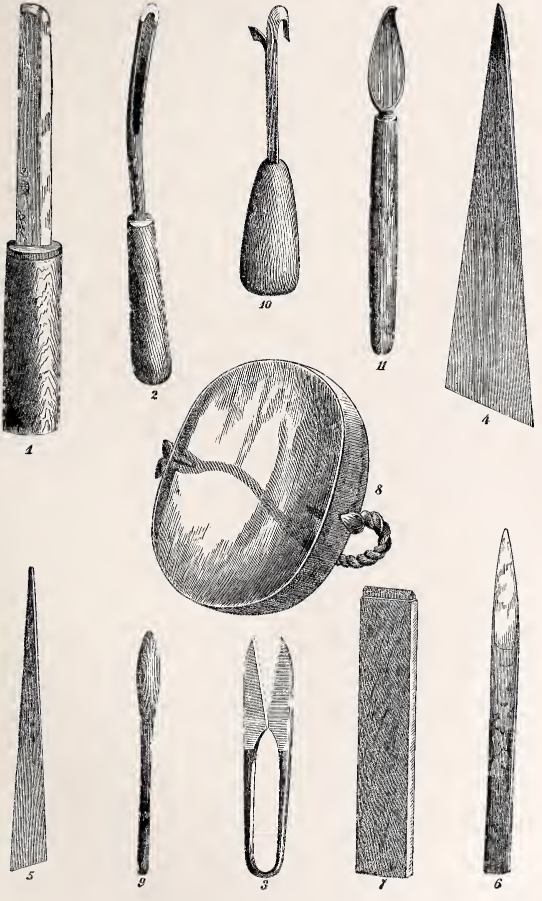
5. The drying of all genuine lacquer coats must take place in the damp, unwarmed atmosphere of a chest, cupboard or chamber. In order to secure this the chest is laid on its side and washed with a wet cloth. Then the lacquered articles are put in, and the cover, which has been washed also, is closed. The drying cupboard with shelves is treated in the same way.

6. Such an arrangement serves to keep off draughts of air, dust, and light during the drying.

7. Every fine, finishing lacquer-varnish before it is laid on must be pressed once or twice through Yoshino-gami, (a fine porous but strong Broussonettia bast paper) by turning at both ends in an opposite direction. Moderately warmed, it flows more freely, and hastens the process.

8. After almost every new coating, according to its nature, comes rubbing off, or polishing with polishing stone, with magnolia charcoal or burned hartshorn (in the first two cases of course with the addition of water), according as this operation follows groundwork or a later coating.

9. The carefully lacquered article when finished must not in any wise reveal the make or material of its framework, must be free from accidental unevennesses, cracks and spots, must have a mirror-like surface and not change in drying nor by heating with warm water. Finally, when breathed upon the moisture must disappear



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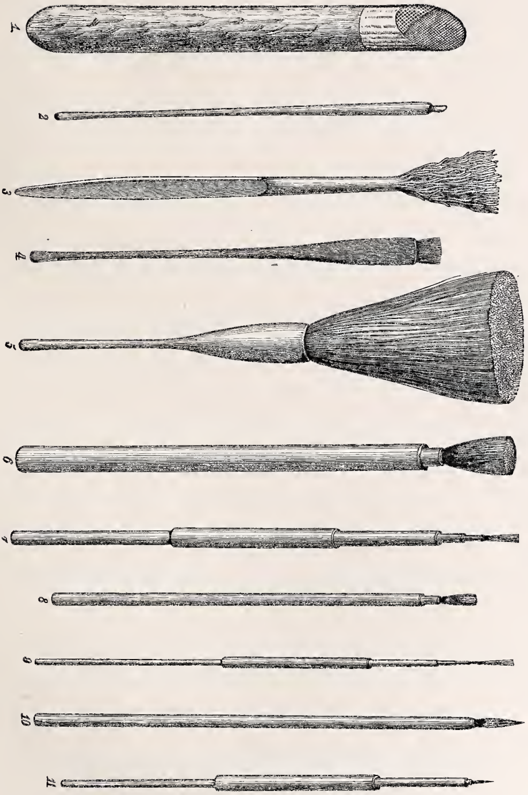

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quickly and evenly from the outside toward the centre, as on polished steel.

The Japanese lacquering process which I shall treat of in the following pages is as different from ours as the material employed, but still it is not always the same; for instance, in what concerns the method or painting the groundwork, which can vary very greatly not only according to the nature of the material underneath but also the article. It appears to me necessary only to set forth the better, more careful manner of treatment, with wood as material, after which the more valuable old lacquer wares were made, as also the before-mentioned samples of the collection which I placed in the Royal Industrial Art Museum in Berlin. In conclusion, I shall briefly show the manufacture of the common market ware and the process of lacquering ceramic productions.

We distinguish two classes of Japanese lacquerers, as has been said before—the Nushi-ya and the Makiye-shi.

A.—Work of the Nushi-ya.

a. Preparatory or Groundwork, Jap. Shita-ji, also called Togi-tate and Naka-nuri-togi-tate.

1. The Kokuso-o-kau or luting process. After the article is placed in the hands of the lacquerer, completed and smoothed by the joiner, the lines of joining, the wooden pin-heads, knots, and other defective places are shaved off with knife and chisel, and the cracks or furrows filled up with a kind of putty. This lute or cement, Kokuso, is made as follows: equal quantities of rice-paste and Se-shime-urushi are mixed together, then reduced with finely scraped hemp bast, lint or cotton wadding as evenly as possible to a jelly. This is laid on with a pointed spatula (Take-bera). The putty, at first a greyish brown, turns to blackish brown very soon, and holds exceedingly fast.

2. The Ki-gatame, *i.e.* the sizing or staining of the wood (from Ki = wood, katameru = to size). The staining material is Se-shime-urushi with or without the addition of paste, and is applied with the spatula or flat brush. This process has a double purpose, viz. to fill up the cracks and pores in the wood which still exist, and to furnish a groundwork upon which the paper or covering (4) will stick better.

3. The Hi-komi (hiku = to cover, komu = to press in) is only used on the places already treated with Kokuso-o-kau, and serves to fill up, smooth off, and as an entire protection against the striking in of the following coats. The putty used is a mixture of Ji-no-ko (Ji = ground, ko = powder)—a yellowish brown or red powder, made from bricks or pieces of common pottery (Kawarake), with some water, paste and Se-shime-urushi. After this is dry follows rubbing down of unevenness with Ômura-do, a sandstone from Ômura in Hizen.

4. The Nuno-kise or Kami-kise, *i.e.* covering (kiseru) with hemp canvas or paper. Paste and Se-shime-urushi are mixed thoroughly to a thin pulp, with which the article is thinly coated. A sheet of Mino-gami (strong Broussonetia bast paper from the province of Mino), or thin hempen cloth, is laid on and pressed down smooth and firm with the spatula. The edges are clipped off evenly with the shears, and a thin coat of lacquer is put on with the spatula or brush. The great importance of this whole process to the durability of the lacquer ware is obvious. On the one hand the cover forms a sort of partition, which prevents the exudations of the volatile oil and resin of the wood from penetrating the lacquer varnish outside, and on the other gives to the wood also greater firmness, hindering especially its warping. Naturally, only the strong, long-fibred Japanese hand-made paper will answer this purpose, and not the chopped-up machine-made paper of the " rag engine."

5. The Kata-ji (Kata = firm, ji = ground), is a fairly thick coat of stiff putty, which is prepared like the Hi-kome (3) and applied with the spatula. It is often repeated after drying and smoothing off the inequalities by means of Ômura-do.

6. The Kiri-ko, *i.e.* mixed powder. Pulverized ochre (To-no-ko), is mixed with water to a stiff paste and then tempered with Se-shime, a little Ji-no-ko (brick dust) and paste (Nori), and thoroughly mixed. It becomes thus a pulp which is easily laid on with the spatula or brush (Hake), and dries in the open air in from 1 to 2 days. Then follows again the polishing off the unevennesses.

7. The Ji-gatame (ji = ground, katameru = to make strong). For this process only Se-shime-urushi is used, worked beforehand with water into a thin paste. The article to be lacquered is painted over lightly with it and then rubbed quickly over with a cloth. When dry it shows a blackish brown colour.

8. The Sabi, derived from Sabi-iro, *i.e.* colour of iron-rust. The article treated with Ji-gatame, is now painted over with a tolerably stiff mixture prepared like that for the Kiri-ko (No. 6), with the exception of the paste, and sometimes of the brick-dust also. Rubbing (togi) again follows drying, this time with sandstone and water, till the surface is smooth and the colour a dark greyish brown.

9. The Sumi-bike, or coating (hiku) with India-ink. A poor quality of the ink is ground hard with water and then rubbed in with a little ball of cotton.

10. The Naka-nuri (naka = middle, inner; muri = lacquering). Naka-nuri-urushi a poor kind of Hana-urushi (see page 353) is a shiny, black, thick lacquer, which is mixed with from $\frac{1}{10}$ to $\frac{1}{15}$ of its bulk of Se-shime, and a few drops of Saké or rice-beer, and then pressed through a layer of several sheets of Yoshino paper. The application is made with a flat brush, and the drying takes place in a closed, damp room.

Then follows the Naka-nuri-togi, *i.e.* the rubbing down (togu) of the Naka-nuri coating. This work consumes a great deal of time, but is very important. It must be continued till all the lustre has disappeared and the surface is perfectly smooth. The workman uses for this process the fine-pored light Hô-no-ki-sumi, the charcoal of Magnolia hypoleuca, which he holds in the first three fingers of his right hand, and a wet cloth is held in the remaining part of the hand. Besides these, he has by his side ready for use a pail of fresh water, and a small polishing stone on which he rubs off and sharpens his charcoal from time to time. When the work is finished, the article is perfectly smooth and of a dead black colour. The groundwork is now ended. It has served the purpose of making the wood more durable, and covering it so that nothing can be seen of its nature or the lacquering be influenced by it, and so that the further coatings will not strike in.

The divergences from this very minute but thorough groundwork process, which was always formerly followed in making the best lacquer wares, are such as are calculated to save material, especially Se-shime-urushi, and time. They are as follows :—

1. In process 4, the article to be lacquered is not covered with canvas or Mino-gami, but it is considered enough to cover the joints, which have been smoothed over with Kokuso, with strips of cheap writing paper.

2. The Shita-ji (Shita = under, ji = ground) takes the place of the operations 3, 6, and 7. The lute used in making this groundwork contains no lacquer-varnish, but is a mixture of boiled glue, brick-dust, lampblack, and hot water. This is used to paint over the bottom of tea trays, but not the sides, nor dishes, boxes, etc.

3. The Sabi is applied twice.

4. Between the 9th and 10th process, there is a new one, a coating of Shibu, the juice of unripe fruits of the persimon (*Diospyros kaki*).

5. The Naka-nuri-togi is much more superficially done.

In Wakamatsu, Yonezawa, Niigata and other northern cities where lacquer industry is a specialty, a mixture of Shibu and pulverized pine-charcoal or lampblack follows immediately after puttying (Kokuso-o-kau), and then comes rubbing off, which ends the groundwork process.

Ceramics which are to be ornamented with lacquer must be unglazed. Putty will not adhere to glazed clay wares, nor will lacquer, as is shown by three Chinese vases in the Royal Porcelain Collection at Dresden, whose lacquering on glaze has pulled off in many places. The groundwork is done by Sabi (see process 8, above) and Naka-nuri.

b. Final Work of the Nuri-mono-shi.

Whatever may be the manner of groundwork, the process of rubbing till a smooth though not reflecting surface of dark grey to grey black is reached, is the final one. On this under layer are laid all the varied coats which impart to the finished Japanese wares their varied appearance. It is almost impossible to give here all the manipulations and artifices, still a short description of the most important categories of ordinary Japanese lacquer wares and their mode of preparation seems to me demanded. There will be considered :

a. Simple Lacquer Wares of One Colour.

1. Nuri-tate is not only the name for a finishing lacquer, but also of a particular process, viz.: the simple lacquer coating which is not followed by rubbing and polishing. It shows striation in one direction produced by the strokes of the brush, is finished with one coating on the groundwork after the Naka-nuri-togi, and after hanging or lying in the drying room from 1 to 2 days is perfectly firm. As I have said before concerning the several lacquer colours, black is obtained by a coat of Jô-hana or Rô-iro, red by cinnabar lacquer, greenish yellow by orpiment lacquer, and green by adding Sei-shitsu to a transparent lacquer. By mixing black with cinnabar a brown of various shades is obtained, also clouds of light green by a larger quantity of orpiment, and dark green by the admixture of Jô-hana or some other black lacquer with the green.

2. Shun-kei-urushi or Nojiro-Shun-kei is the name of a peculiarly lacquered, yellow wooden ware from Nojiro, a small town north of Akita, near the Japan Sea. Usually in the common lacquer wares the groundwork is made entirely to conceal the character of the wood beneath it, but in this variety the natural veining of the wood is well preserved. After a careful staining of the wood with Se-shime lacquer, with or without the pore-filling admixture, follows a careful rubbing, then a lighter coat of solution of gamboge, or some other yellow liquid dye (*e.g.* from the fruit of Gardenia florida), and finally a thin coating of transparent lacquer, the Shun-kei-urushi. Generally the yellow vegetable dye is mixed with this last and put on at the same time. On account of the large proportion of oil in this lacquer, the usual rubbing and polishing cannot follow its application, and the article must be left as it is. There must therefore be greater care and cleanliness in the preparation and use of this lacquer than ordinarily, so that the finished product may be free from spots and brush strokes. In this way it shows a transparent yellow or brownish yellow colour, the veins and spots of the wood, and a high lustre. Nojiro-Shun-kei is, however, a rather expensive ware and is seldom exported.[1]

[1] I did not visit Nojiro, and only saw imitations in Tôkio, which do not equal the beauty of the originals, of which the Royal Industrial Art Museum in Berlin has several fine samples. It is doubtful whether these are made exactly as described above, for all who have mentioned Nojiro-Shun-kei say that its method of manufacture is a trade secret, and that the workmen do not all follow the same method. See K. Hagmeier, in "Mittheil. der deutschen Gesellsch. Ostasiens," 12 Heft, p. 65.

3. Tsuya-keshi (tsuya = lustre, kesu = to wash out, drive away), is a dull black lacquer coating, obtained by painting on the groundwork with Rô-iro-urushi, and polishing after drying with Rô-iro-dzumi (coal of the Lagerströmia indica), then a coating of Se-shime-urushi, and rubbing with soft paper.

4. The Rô-iro. This lustrous black lacquer is accomplished very much as the preceding, only that at the end of the process it is further treated with Suri-urushi (polishing lacquer). Polishing is accomplished by three alternate rubbings of Se-shime-urushi and powder of burnt hartshorn. The fingers and ball of the left hand are used in rubbing instead of leather.

β. Coloured Lacquer Wares, with Marbled Surface.

1. Tsugaru-nuri, Tsugaru lacquer (see Plate V. Fig *a*). This variety takes its name from the district of Tsugaru (pronounced Tsungáru), in the north of Hondo, opposite the island of Yezo, in whose capital city, Hiro-saki, this method of lacquering is much employed, and reaches its greatest technical perfection. The peculiarity of Tsugaru-lacquer consists essentially in having four or more colours, black, red, yellow, and green, proceeding from Rô-iro, cinnabar, orpiment, and Sei-shitsu lacquer mingled in several motley combinations. Sometimes it is in regular stripes, sometimes with more or less irregular spots and indistinct figures, again in an utterly indiscriminate mixture of spots and points, that these colours appear. One of the colours is usually more prominent than the others, and often one is entirely wanting.

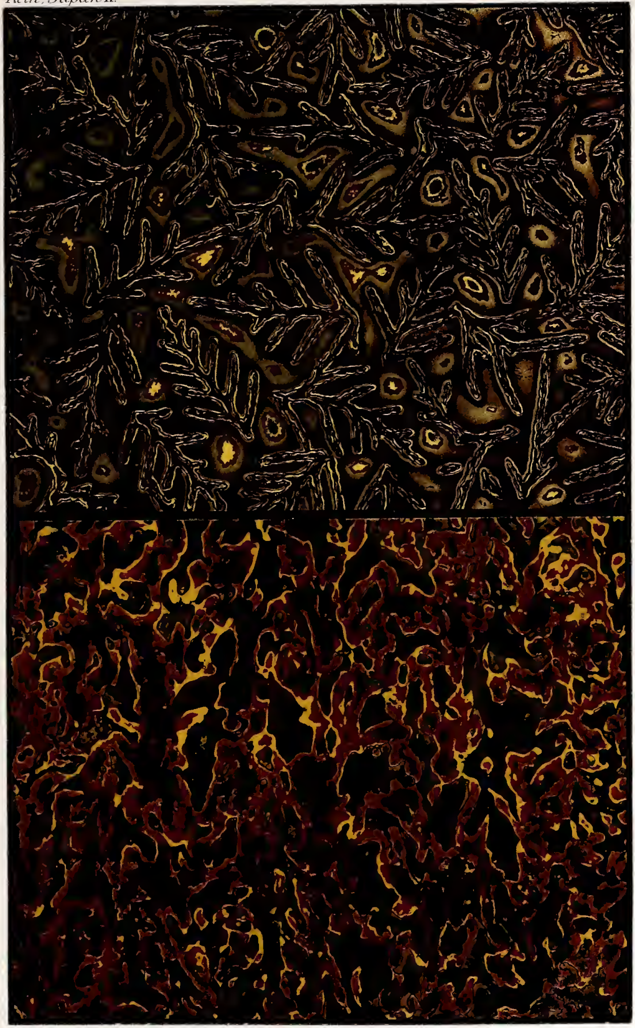
Tsugaru-nuri is not frequently seen, at least in European collections, as its manufacture demands much time, and its price is correspondingly high. The best older specimens of it, and of Wakasa-nuri (the following group), I saw at the Hague (Museum of Curiosities), and in the Ethnographical Museum at Munich.

Tsugaru-nuri is made by going over the groundwork after the Naka-nuri-togi process, with a tough putty made of the white of eggs or some kindred substance (*e.g.* Tôfu and Rô-iro-urushi), to form an uneven surface, which is then painted with red, yellow and green lacquer, succeeding each other in any desired order, followed by a coat of transparent lacquer. The surface is then rubbed with charcoal and water till the desired marble appearance is obtained. Its character depends on the manner in which the putty is laid on, whether evenly on the groundwork with the figures and furrows pressed in, or transferred by a stippler to the ground coating, making an uneven surface from first to last. It also evidently depends on the order in which the several colours follow each other, and finally on the amount of polishing off. When this is finished, then follows the final work: first a coating of Se-shime mixed with Nashi-ji, again rubbing with charcoal and then polishing till a mirror-like appearance is produced, in which rape oil and bole or some other fine mineral powder are used with Seshime.

2. Wakasa-nuri, Wakasa lacquer (Plate V. Fig. *b*). The province of Wakasa, from which it derives its name, lies on the Japan Sea, north of the Biwa Lake. It is said that this kind of lacquer first came into vogue in its capital Obama, from Chinese samples. It is distinguished from Tsugaru-nuri especially in having gold-yellow, orange, and brown in addition in its colouring. These last predominate largely also, often appearing alone or in connection with only a part of the Tsugaru colours. Gold-yellow, brown, and orange are generally produced from gold, and but seldom from silver foil. As in the process given for Tsugaru lacquering, an uneven surface is laid on the finished groundwork. Then come coats of several lacquer colours, one after the other. After the last colour, the gold foil is laid on, and made fast by the brush. It accommodates itself to the uneven surface and adheres firmly everywhere. The article is allowed to dry, then given a coat of transparent lacquer, which is repeated if necessary till the hollows are filled up, and a smooth surface is obtained. The usual rubbing with magnolia charcoal and water follows, by which process the necessary lustre is reached.

Plate V. Fig. *b* shows an imitation of such a specimen of Wakasa-nuri with bronze colours, but does not equal the beauty and polish of the original in the Industrial Art Museum in Berlin. This specimen, now 180 years old, is a little box of great beauty, and of such lustre that it seems as if freshly polished. Nevertheless the pictorial representation of a part of its upper surface serves to illustrate the manner of its accomplishment. It will be seen how, after the production of the uneven groundwork, twigs of Arbor-vitæ (Retinispora) are pressed into the hollows of the albuminous putty, and then when fully dry are taken away again. The succession of the lacquer coats is also easily observed, viz. black, greenish yellow, and red. Then came the laying on of the gold-foil, the filling of the unevennesses with transparent lacquer, the rubbing with magnolia charcoal and water, the repeated very thin coat of transparent lacquer, and then the process of polishing as has been given in other cases. In conformity to this, we see the gold foil stand out in its natural colour, wherever it lies on the ridges of the groundwork, and then in shading to brown where it has been placed in the hollows, and covered over with several thick layers of the transparent lacquer. Where the edges of the twigs pressed the putty upwards, red, greenish yellow, and black bands or rings or spots succeed the yellow of the gold foil in the order in which (counting backwards) the coats of lacquer were laid on.

3. Shi-tan-nuri, *i.e.* sandal-wood lacquer. Under this class are imitations of the red sandal-wood or Shi-tan (see p. 253). They are produced as follows: After the groundwork is finished, the article receives a coat of cinnabar lacquer. Before it is fully dry



a

b

Verl. v Wilh. Engelmann, Leipzig *Lith. Anst. v Werner & Winter, Frankfurt a/M*

LACQUER PATTERN

a. Tsugaru-nuri, b. Wakasa-nuri.

it is marked in interrupted parallel lines with a sharpened stick. After drying comes smoothing with charcoal as usual, and then laying on of India-ink in stripes, and a washing away of the edges, so that red and black stripes alternate, but not showing any resemblance to wood. A thin coat of Se-shime and the polishing process follows. The effect is surprising, but it needs a great deal of practice and a skilful hand, especially in rubbing with the magnolia charcoal.

This kind of Japanese lacquer ware is seldom met with in the European collections. I found it in 1881, in the shop of Larkin, Grafton Street, London, on a wooden vase which was made in the shape of a blunted cone 1 meter in height, 56 centimeters in circumference at the bottom, and a diameter at the top of 30 centimeters. Its price was £100. The ground showed the most beautiful imitation of red sandal-wood that I have ever seen. The decorations, original of their kind, were of raised gold lacquer work and inlaid with ivory and mother of pearl, and represented the Schichi-ken or seven wise men of China,[1] cranes and bamboo cane.

4. Suri-hegashi-nuri, *i.e.* lacquer work obtained by hegu = stripping off, and suri = to polish. To prepare this, a coat of black lacquer (Rô-iro-urushi) follows the Naka-nuri-togi, or final process of the groundwork, then a slight rubbing with charcoal and water, a coating of red lacquer made from cinnabar and Nashi-ji-urushi, and then a second rubbing with charcoal and water. The dark figures are produced by continual rubbing with sharpened charcoal on particular places, even to piercing through the cinnabar lacquer. The articles are repeatedly rubbed over with balls of wadding and Se-shime-urushi, to fill up the hollows, and are finally polished as usual after the last drying. They are coarsely marbled, or show either single black spots on a red ground, or the reverse, red spots on black ground. There are many variations of this process, among them that in which gold-foil is spread out over a layer of black or brown lacquer, and symmetrical figures are engraved in it when dry, at the pleasure of the designer. Afterwards it is filled up and covered with transparent lacquer, and then follows polishing.

5. Same-gawa-nuri, *i.e.* " Shark-skin lacquer," or Same-dzaya, *i.e.* " shark sword-sheath,"[2] We have now to consider a peculiar

[1] These "Seven Wise Ones" (Schichi-ken) were the cynics of China, misanthropes who went so far as to not only rend their clothes and go about naked, but also to choose their place of abode in bamboo thickets, like the wild beasts.

[2] Shark skin must not be here understood to mean the coarse shark skin called Shagreen, or the skin of the *Hypolophus Sephen*, Mull. and Henle, but the skin covered with bony tubercles from the back of several species of Rhinobatus or roaches of the coasts of Hither and Further India, also of Southern China, especially that of *Rhinobatus armatus*, Gray, and Rh. granulatus, Cuv. (See Müller and Henle: " Systematische Beschreibung der Plagiostomen," Berlin, 1841, p. 117.) At any rate I saw in the French exhibition the skin of a Rhinobatus from Cochin China, marked "Pegu de Requin," and answering entirely to that used in Japan.

method of lacquering which derives its name from the shark skin (Hai-haut), or the sword sheath (Saya), principally employed in its decoration. Usually the shark skin is firmly pressed, by means of a tailor's flat-iron, on the article to be lacquered, without previous groundwork, but after it has been coated with fresh rice paste. Its uneven surface is then filed down with an iron file, the hollows filled with applications of Sabi (p. 358), and then follow the rubbing with charcoal, coat of Rô-iro-urushi, repeated rubbing with magnolia charcoal, and finally the polishing with burnt hartshorn and Seshime-urushi three times repeated. The finished product now shows a black ground, sprinkled closely with tiny, white circles.

In the Ducal Museum at Gotha, there is a small old box in this style of lacquer. Where the circles appear grey or bluish, the shark skin has been previously dyed with indigo. This shade of lacquer, which is generally found on old sword sheaths, is called Ai-dzame (Ai = indigo, and dzame = shark). Since the old swords and their sheaths have gone out of use, Same-no-kawa is but little employed in lacquering.[1]

γ. *Coloured Lacquer obtained by Dusting with Glistening Powder.*

1. Ao-gai-nuri or Ao-gai-togi-dashi, mother-of-pearl lacquer, in making which the coarse or finely pulverized mother-of-pearl from varieties of Trochus and of Haliotus is used. If whole surfaces are to be strewn and evenly adorned, the work is quite analogous to that where metal powder is employed. If, on the contrary, definitely outlined decorations are intended, it is customary to paste stencil patterns of tin-foil on the surface of the groundwork, and giving the open spaces a coating of Rô-iro-urushi, to sprinkle them with Ao-gai or mother-of-pearl powder. When dry the patterns are removed, and the whole is coated with a mixture of Rô-iro and Se-shime-urushi, and then the strewn mother-of-pearl is carefully rubbed with magnolia charcoal. A second coat of the same lacquer varnish follows, then the second rubbing, and finally polishing. The same course is pursued in the simpler work of strewing the whole surface evenly with mother-of-pearl. The beautiful green and violet iridescence of small mother-of-pearl pieces on the lacquer wares decorated with it depends on its varying position toward the light and the uneven coating of the transparent lacquer varnish.

2. Shari-nashi-ji, *i.e.* tin (dust) pear ground. The tin dust (or bronze powder instead) is strewn with a little sieve, evenly or in

[1] The Paris manufacturer, Giraudon, some years since applied for a patent for the employment of the same kind of shark skin which the Chinese and Japanese formerly used in lacquering. At the Universal Exhibition in Antwerp his exhibit contained a magnificent collection of "Articles de luxe en Requin de Chine," such as cabinets, glove-boxes, bowls, etc., all covered with well-polished shark skin, and which were sold at enormously high prices.


a
b
c

Verl. v Wilh. Engelmann, Leipzig Lith. Anst. v Werner & Winter, Frankfurt a/M.

LACQUER PATTERN

a. Kin-ji, b. Nashi-ji, c. Moku-me.

stripes and figures on the moist coat of Naka-nuri (see 10th process of groundwork), and when dry covered with a coat of Se-shime. With this it takes a brown colour, like the scattered powder of a precious metal. The gold ground becomes lighter yellow and more lustrous with age, the scattered tin or bronze dust on the contrary grows darker and duller, as may be easily observed in many of the common Japanese lacquer wares. It is to be understood that the strewing of metal powder does not finish the work, but that a coat of transparent lacquer, and the polishing process must follow.

3. Simple lacquer wares, ornamented by inlaid work. I rank this group next to the preceding, because its execution, though demanding some skill, does not any more than the foregoing necessitate a real artistic talent. The precious metals also are either not at all, or at least only exceptionally, employed in this. The inlaid mother-of-pearl work, Ao-gai-zaiku, as cabinets, boxes, dishes, etc., which are brought in such numbers to Europe, and made chiefly at Nagasaki, belong principally to this class. It is customary, however, to incrust even the finest lacquer wares with mother-of-pearl, ivory, and precious metals, and to form from them reliefs of flowers and other natural objects.

This branch of lacquer industry is already old, as articles in the Dutch, Dresden and other collections testify. The common Ao-gai comes from the inside of the shell of the Haliotis, each shell yielding only one thin plate. The finer or Ma-gai Ao-gai, *i.e.* Ao-gai imitation, is the product of the large Trochus, and comes principally from the Riu-kiu islands. Both kinds (in Trochus, the last convolution), are scaled off in thin, transparent sheets, in a painstaking primitive way.

The mother-of-pearl sheets are laid on the design, which is pricked through with India-ink and brush. The painting colours (Prussian blue, gamboge, and a mixture of the two for green, also sienna, carmine, cartharmine, etc.) are rubbed together with hot glue-water and laid on with the brush according to the pattern, on the right places in the mother-of-pearl. When dry, their painted portions are covered with silver-foil laid on with glue-water, and again dried. Then the mother-of-pearl is cut with a sharp chisel into the shapes designated on its opposite side (leaves, flowers, etc.), with their corresponding transparent colours. They are glued on the dull groundwork of vases, plates, cabinets, etc., and all the hollow intervals of space are filled up with black lacquer. Then the whole surface, including the inlaid work, is covered with two coats of transparent varnish, and if necessary rubbed with charcoal and polished. The underlying silver-foil is used to protect the colours on the underside of the mother-of-pearl from the lacquer, and to bring them out more clearly; but this is done only in the more valuable articles. Instead of mother-of-pearl an inlay of tin is sometimes used, which is treated of course differently, and then never loses its colour and polish.

B.—Work of the Makiye-shi.

This has for its object the artistic ornamentation of lacquer-wares in which the use of gold and silver dust plays an important part. The representation of a picture, or description of any other work of art, has its great difficulties, and it is moreover impossible to teach an art by description. The Makiye-shi or gold-lacquer painter practises a real art. He must combine a long apprenticeship, often from eight to ten years, with unmistakable natural talent, before he can succeed in working as a master in his department, and be able to create with skilled hand those artistic decorations whose perfect beauty we admire in many of the Japanese lacquered articles.

On this account, the following can be but a brief statement of the universal method of his work, and of the principles recognised everywhere as governing it, notwithstanding its great variety. In addition to the rules already (p. 356) stated, which are the same for all workers, these principles are as follows:—

1. The Naka-nuri-togi or final process of the groundwork must be performed with the greatest care, and form a perfectly smooth surface.

2. On this base the design is sketched freehand with a fine brush and a thin paste of white lead or some other colour, and water, or—when the artist is less skilled—a pattern is pricked through and then put on with Shita-makiye, *i.e.* "drawing of the under ground." This is done in a brownish red thin colour, made by mixing red oxide of iron (Beni-gara) with Se-shime-urushi.

3, Gold, silver and other colours are almost all strewn in powder over the moist Shita-makiye, or at the side, and then swept on with a brush (Plate IV. figs. 5, 6, or 3). This is done especially in cases like wood imitation, when the colour is to shade away and diminish from a certain line. Polishing of course follows the drying of a coat of light-coloured varnish, usually Nashi-ji.

4. That which is to stand out in relief is at first sketched in outline only, and not treated further till all is finished on the surface.

The most notable and important decorative material of the Makiye-shi is gold. It is used in a powder in two principal shades, under the names Yaki-gane and Koban. Yaki-gane, *i.e.* burnt metal, or Yaki-kin, *i.e.* burnt gold, is a pure, deep yellow, so-called ducat gold ; Koban on the other hand is a green coin-gold, an alloy of 7·4 parts gold and 2·6 parts silver. Other alloys poorer in gold are also used. A large number of varieties of gold and silver filings are distinguished according to the grade of fineness, and are separated by a sieve, and called by particular names ;—Kin-pun or Keshi-ko is the finest gold, and Gin-pun the finest silver-dust. It is obtained by covering with glue the corresponding metal foil of the gold beater, pulverizing it when dry, and then separating the metal from the glue by washing.

As some of these powders are more often used, the names of the most important are given, in the order of their fineness, so that the coarsest stand first, in order to be able to use the shorter numbers for their long designations :

1. Kiri-kane, small square leaves of gold-foil.
2. Yaki-gane, hira-me tsune san.
3. „ hira-me shô san.
4. „ nashi-ji shô san.
5. „ koma-ka-me tsune.
6. „ mi-jin tsune.
7. „ koma-ka-me mi-jin.
8. „ maru ara-goku.
9. „ goku gashira dai.
10. „ goku gashira shiu.
11. „ maru goku mi-jin.

These names are difficult to translate Mi-jin and also fun (pun) mean, fine dust ; tsune is common, ara = coarse, goku (koku) = thick, komaka = first powder.

12. Koban, ara-goku.
13. „ ara-mi-jin.
14. „ mi-jin tsune.
15. „ hana-ko.
16. Gin-pun, silver-dust.

Besides these pure gold and silver powders and filings, there are several mixtures of these with colours for shading. To these belong :—

17. Aka-fun, red powder, a mixture of cinnabar with gold or silver dust.

18. Kuro-fun, black powder, a mixture of camellia charcoal and gold or silver dust.

19. Kuri-iro-fun, chestnut-brown powder, a mixture of gold dust, cinnabar, and camellia charcoal.

20. Nedzumi-iro-fun, grey rat colour, made of equal parts of silver dust and camellia charcoal with some cinnabar.

21. Shu-muki-gara, old scrapings of cinnabar lacquer, finely pulverized.

22. Matsu-no-sumi-no-ko, fir-charcoal powder.

The decorations of the Makiye-shi may be classed in two groups, viz.—

(*a*) Hira-makiye, *i.e.* flat gold lacquer work.
(*b*) Taka-makiye, *i.e.* raised gold lacquer work.

(*a*).—*Hira-makiye, Flat Gold Lacquer Work.*

As the name indicates, these decorations remain flat or smooth on the surface, while those of the second class stand out in *bas relief.* Hira-makiye embraces all the ornamentation of the finer Chinese wares, *e.g.* those of Canton and Foochow, and a large number of the most prized and most used of the Japanese. They are principally surface decorations with gold dust, as follows :—

1. Nashi-ji, pear ground (see p. 352). This designation is generally understood to mean a ground of black lacquer on which coarse or fine gold dust is evenly strewn, and then varnished over with a transparent lacquer. We have here to treat of Nashi-ji in its first original meaning. The black groundwork, according to the quantity of gold dust scattered over it, either predominates or is more covered, indeed in the most valuable Nashi-ji disappears entirely. Its appearance then resembles in its fresh condition, Aventurine, so that Wagener's designation "Aventurine lacquer" (*Dingl. Polytechn. Journ.*, 1875, p. 366), appears very suitable. Plate VI. Fig. *b*, gives a sample in bronze. The original of this made from the powder of ducat-gold shows this colour only when fresh, but becomes much yellower and more lustrous with time. The production of Nashi-ji is simple. The moderately fine gold dust is strewn on the coating of Shita-makiye-urushi with a little hand sieve, usually similar to that mentioned in No. 4 of our list of implements used in lacquer work. After it is dry, the dust that does not adhere, is carefully swept away, and then a coat of Nashi-ji-urushi is given, which commonly takes from 6 to 7 days to dry. Then comes the usual rubbing with magnolia charcoal and water, and afterwards polishing. Both operations manifestly require great care and skill.

Nashi-ji is one of the most frequent and popular modes of surface decoration. The fine particles of gold dust and foil have at first a brownish yellow colour, but always with age become brighter and more brilliant, because of the greater transparency of the lacquer varnish, so that one can judge of the age and quality of the lacquered articles by the evenness, fineness, and colouring of the coating. In many of these older gold lacquer wares, as bowls and boxes of various kinds, the inside is covered also very carefully with Nashi-ji of the best kind. The work is as ancient as ornamentation with mother-of-pearl. Both may be traced back to the end of the eighth century, to the time when the Emperor Kuwammu-Tennô made the city of Tôkio the permanent residence of himself and his successors. The Nashi-ji, which is an imitation in ordinary lacquer ware with tin and bronze, has already been described.

2. Kin-ji, "Gold ground." The groundwork which is to be ornamented in this particular way is first given a coat of thin Shita-makiye-urushi, and then quickly and evenly strewn with a fine gold powder (No. 7, or some other on the list) by means of a sieve, till entirely covered. After drying and brushing off the non-adhering particles, comes a coat of Nashi-ji-urushi, then another drying, rubbing with magnolia charcoal, and a thorough polishing, in which Yoshino-urushi, or Se-shime, hartshorn, and other substances are used to produce a perfectly even, mirror-like gold surface. Kin-ji, like Nashi-ji, also grows lighter and brighter with increasing age, while its imitations with tin dust or bronze,

tarnish after a little while, lose their metallic lustre, and become a dull yellowish brown. Plate VI., fig. *a*, represents such an imitation.

This costly decoration, Kin-ji, which looks like a thin covering of gold leaf, is found very often in old lacquer wares of great value, *e.g.*. on boxes, medicine chests, India-ink boxes, and other articles. Gin-ji, or silver-ground, is used much less often on larger surfaces, but is prepared with silver dust in much the same manner. In Plate VII. the moon and one chrysanthemum are imitations of Gin-ji.

3. Mokume, spotted texture (moku = veined or curled wood, kime = texture), or curled form (Plate VI., fig. *c*). The veins and speckling of the wood is sketched with white lead or colcothar, but the working out is done by degrees, perhaps beginning at the middle of the surface to be decorated, or from the centre of one of the spots. The Makiye-shi presses through Yoshino paper the brownish red colour, which is made by mixing red oxide of iron and Se-shime-urushi together, when necessary thinning it with camphor; he then puts his little horn palette (Tsune-ban, see Plate III., fig. 8) over the thumb of his left hand, lays some of the colour upon it, and begins his work at the centre of one of the spots, going over the faint outlines with red on the point of a fine rat-hair brush, and then covering also the surface so outlined with the same colour. He next takes his little sieve (Plate IV., fig. 1, or one similar), with a small amount of gold dust, and if, as in this case, an even, gold, mirror-like surface is desired, strews the little bit of surface freshly coated with Shita-makiye; or, if the reflection is to decrease, growing feebler towards the centre, the dry outer side lying next to the edge, in which case the powder is brushed on the moist figure, these girdling outlines, *e.g.*, and then toward the centre of the spots. Deep yellow is obtained from a fine powder of Yaki-gane, yellowish green and light yellow from Koban. When the centre or eye of the spot is covered, the painter proceeds next to the first girdle, the second, and so on. When the whole ground has been treated in this way, and left in the damp drying-room for a day, superfluous particles of gold dust are brushed off, and the surface of the Mokume receives a thin coat of Nashi-ji-urushi, for which Se-shime can also be used. Then follows longer drying, rubbing with magnolia charcoal, another varnish of the same lacquer, another drying and rubbing with charcoal, and finally the work to produce the proper lustre.

The effect of Mokume work is heightened by alternation of the so-called yellow, red, and green gold dust by other tints, and by strewing mother-of-pearl powder over it. This surpasses Nashi-ji and Kin-ji, and wherever it appears is a mark of costly lacquer-work.

4. Kara-kusa = arabesques, and kumo = clouds.[1] Besides the

[1] The name Kara-kusa, China-weed, used for arabesques, indicates the Chinese origin of this manner of decoration, as it is there much more extensively employed, especially in ornamenting bronze vases, than in Japan.

already mentioned employment of gold dust in wood imitations, silver dust, mother-of-pearl, and powder of old cinnabar lacquer are all used for the same purpose. After the whole design is outlined, strewed with these powders, dried and coated over with Nashi-ji-urushi, the first rubbing with charcoal, and then a varnish of Se-shime takes place. In order to bring up the deep, black interstices to the level, it receives now, as after the laying on of the flowers and other ornaments, a coat of Rô-iro-urushi. After drying, follows the second rubbing, and then polishing. Veins of leaves, outlines of clouds, and other prominent lines during this last process are emphasized with the brush, Shita-makiye and gold dust, but must be rubbed off with charcoal before polishing. (The sample collection in Berlin possesses two tables of this kind of work.)

5. Monsha-nuri, named after a silk material having similar design, is a peculiar kind of lacquer ornamentation which may be classed here, though it properly does not belong to gold lacquer. But it is also worked by the Makiye-shi, and demands no less artistic skill than the before-mentioned varieties. After the figures (birds, flowers, etc.) are laid on with Shita-makiye, the still moist lacquer is strewn with finely powdered pine charcoal (other kinds of charcoal weaken the lacquer more or less and are not so suitable). This is done with a little sieve which is made by cutting a piece of bamboo cane diagonally across and then covering the end with fine muslin, gauze, or woven wire. When dry, the superfluous powder is swept away with a soft brush, and the entire article receives a coat of Rô-iro-urushi. Then follows rubbing and polishing. The figures are thus made to have a dull appearance against the shining black surface. The effect is surprising. It is obtained by very simple means, and without the smallest use of metal dust. (There is a table in the Berlin collection, with the Hôwô, or Phœnix of the Chinese mythology, represented in several side and front positions in the above manner.)

(*b*).—*Taka-makiye—Raised Gold Lacquer Work.*

In addition to all that has been said in general concerning its production, I will only add that the Taka-makiye-urushi, or the putty which is used therein, has a brilliant black colour when dry. It is not applied directly to the ground reserved by the outlined design, but this is treated beforehand with a coat of Shita-makiye-urushi, which has been strewn with charcoal dust and some orpiment. The putty itself is a mixture of black lacquer, lampblack, a little white lead and camphor. The reliefs modelled in it adhere very strongly to the groundwork when dry and have the appearance of coats of Naka-nuri. Like these they are rubbed with a pointed piece of charcoal till all the small furrows are smooth. The further processes are much the same as those of plain surfaces, and follow in this order: coat of Shita-makiye, scattering metal dust, varnishing with Nashi-ji-urushi or Se-shime, rubbing with magnolia charcoal and water, and finally the several processes for obtaining the requisite polish.

In cheap lacquer wares, wherever Taka-makiye is used, bronze powder and tin dust are substituted for precious metal, and the whole work is executed at low price and correspondingly small outlay of art or time. It is in the same relation to the exquisite accomplishments of the Makiye-shi, that the wall decoration of the house painter is to the frescoes of the eminent artist. A more comprehensive discussion of the many art fancies and methods of which the Japanese artist avails himself, including the inlaying of ivory, mother-of-pearl, and precious metals, is manifestly quite impossible, and any further explanation in this direction would be neither of interest nor use.

In the moonlight autumn scene (Plate VII.) the artist has employed several of the decorations mentioned under Hira-makiye and Taka-makiye. In it we have night represented by means of the irregularly strewn Nashi-ji on the black lacquer, and by the moon behind a cloud. Autumn is indicated by the wild geese (Gan) flying down, and the two favourite flowers, Kiku-no-hana (*Chrysanthemum sp.*) at the right, and Omina-meshi (*Patrinia sp.*) at the left. The geese, banks of the stream, and flowers are in relief, and are executed last. The flowing water is produced very much as the sample of spotted lacquering (Plate VI. fig. *c*), and Kin-ji (gold ground), Gin-ji (silver ground), and Nashi-ji (pear ground) may be recognised in different places. There is also noticeable in the feathers of the geese, the careful modelling and chasing of the relief before it has received the gold ornamentation. Only one other decorative form of raised lacquer work, the Giyô-bu-Nashi-ji, remains to be briefly noticed. It is often seen on tree-trunks and rocks, is always done in pure gold, and is an unmistakable token of careful labour. We see it on the raised banks of the stream, laid on with squares of gold leaf in rows like paving stones, decreasing in size in the distance, and gradually lost. These pieces of gold leaf, called Kiri-kane (see 1, p. 367), are laid on one after the other with the point of the Hirame-fude (see 7, p. 355) on the places designed and still moist with lacquer.

Tsui-shiu, Carved Cinnabar Lacquer, or Peking Lacquer.

In our Industrial Art Museums, small tables are to be seen from China and Japan, and bearing the name Peking lacquer, or carved lacquer work. Some of these are made with open-work ornamentation, and there are dishes, boxes (Fig. 13), and other articles which differ widely from the earlier mentioned work in their beautiful and very peculiar modes of decoration. On the groundwork intended for this variety, cinnabar lacquer is applied partly pure and partly mixed with Rô-iro, and then several shades of brown in even layers, till finally a firm crust from 1 to 2 millimeters thick is formed. The varied ornamentation of arabesques, flowers, human and animal figures, life scenes and whole landscapes and battle pieces are then engraved upon it, or carved out with a sharp knife, so that the several layers of different coloured material are seen distinctly. This work of course is only possible when the lacquer was warm.

FIG. 13.—COVER OF A BOX ORNAMENTED WITH TSUI-SHIU.

This variety of lacquer work was very popular in China in earlier times. The Emperor Kenriu, for instance, in A.D. 1766, in honour of General Akui, who had successfully put down a great rebellion at Pasen in Western China, ordered a picture of the battle in red lacquer, and also a second picture of equal size to commemorate the entry of the victorious troops into the capital, and their reception.[1]

The process was later introduced into Japan by one of the

[1] See Wikowski; "Erklärung zweier chinesischer Bilder aus rothem Lack," in 10 Heft d. deutschen Gesellschaft Ostasiens. Yokohama, 1876.

Chinese, whose son so altered the method, that he employed variegated mixtures for the single layers between the black and red lacquer, and then engraved the ornamentation deeply, or more often cut it diagonally, so that the several colours appeared one after another in parallel bands.

Such work is no longer in the market in Japan, and is only obtained occasionally from dealers in antiquities. Cheap imitations, however, are very frequently seen. According to one process, the ornaments are cut in wood and then the whole article is evenly varnished with a thin layer of lacquer, and after drying, the carved parts are gone over with a sharp knife. In the other, which is still followed to a small extent in Kiôto, a brown or dark grey putty is prepared from boiled glue, ochre and Se-shime-urushi, with the addition of wheat flour (Ko-mugi-no-ko), which is rolled out in a thin sheet. This is spread out on a board which has been freshly coated with Se-shime-urushi to secure the adhesion of the putty. The desired ornamentation is pressed into, or engraved in the putty and then left to dry. In this way the Kata, or pattern, is obtained.

A second sheet of this same dough is now rolled out, laid on and pressed into the hollow form obtained from the first one, so that the ornamentation remains raised when the form is lifted off. Such a sheet of putty with its figures in relief is then applied to the article which is to be decorated, and made fast to it by a layer of Se-shime. The design is afterward re-engraved so that it may be more sharply distinct. When the material has become fully dry, the article is varnished once or more times with liquid red or brown lacquer. Trays, vases, and other vessels of wood, burned clay and porcelain are decorated in this way. The artistic value and the demand for them are however very small.

Historical Facts Concerning Japanese Lacquer Industry.

Although the age of this industry can scarcely be known exactly, and the legendary history which dates its beginning centuries before the Christian era deserves little credence, it may be accepted as a fact that it did not exist before the campaign against Corea in the 3rd century A.D. The Japanese maintain that Urushi-no-ki, the lacquer-tree, was earlier known in the forests of the country, and that the industry which is founded upon the use of its sap was spontaneously developed. But all proof of this is wanting, while a variety of facts point to China as its source. For one, Rhus vernicifera has not been found growing wild anywhere in Japan, but has sometimes been confused with Rhus sylvestris. Others show that the methods and utensils used in Japan are precisely the same as those which have been used for centuries in the lacquer industry of China. This much may be certainly derived from several portions of the not very reliable history of Japan, that this branch of industry was little known during the first six hundred years. And as the Japanese owe all their other art industries to China and Corea, we may be safe in concluding that the lacquer art also, and probably the lacquer-tree with it, became known to the Japanese from their western neighbours just after the commencement of the third century, or, after their first expedition to Corea.

Undoubtedly, lacquer as a protective and an ornamental covering of a variety of materials and articles did not attain great importance before the middle of the 7th century. Kôtoku-Tennô, the 36th Mikado (645 to 654 A.D.) was the first to have the paper Kamuri, the peculiar ceremonial head covering of former times, covered with black lacquer. The ordinance also of a somewhat later time, which allowed those provinces in which lacquer industry prevailed to pay their taxes to the State in the form of lacquer wares, must be regarded as substantial encouragement to the further development and extension of the industry. The articles at that time were probably all lacquered in simple black, as is the case with the two oldest lacquered articles known, those preserved in the Tôdaiji temple at Nara. One of these, a Kesa-bako or scarf-box, so called because in it are kept the scarfs or sashes which the bonzes wore over their shoulders, belonged formerly to the priest Shôtoku Taishi, who lived in the time of Kinmei Tennô (540 to 572 A.D.). The other is a Saya or sword-sheath which is said to have belonged to the Emperor Shômu, and so dates from the first half of the 8th century. Ornamentation of the lacquer coats with gold dust, and inlaying with mother-of-pearl, may be traced back likewise to the 8th century.

With the rising luxury of the court and the Kuges, while the Fujiwara controlled the government, finer lacquer industry was developed in Kiôto more and more. The increasing feudal power brought it also to the Daimiô seats, but it flourished principally outside of Kiôto, in Sakai and Kamakura. It was the custom at Kiôto, in the 11th and 12th centuries for the court nobles (Kuge) to have the ox-chariots, which they drove by special rights, ornamented with gold lacquer. A new impulse was given to this industry at Kiôto in the beginning of the 15th century, when Ashikaga Yoshimitsu in the height of his power displayed a hitherto unknown splendour. Nevertheless, until the middle of the century (time of Ashikaga Yoshimasa), the Chinese method was faithfully followed, and all decorations, consisting mainly of the representation of blooming plants, were kept to a plain surface, Hira-makiye.

Great progress was shown from this time, more freedom was developed in the choice of decorative themes; landscapes were added to the representation of the varied forms of nature, and were enlivened by a new feature of great importance, viz. the introduction of the Taka-makiye, in raised gold lacquer work. This decoration in relief, with several other specialties, even now essentially distinguishes Japanese lacquer wares beyond those of the Chinese, *e.g.*, those of Canton.

The period of greatest brilliancy in the old Japanese lacquer art was unquestionably the end of the 17th century, the time of the splendour-loving Shôgun Tokugawa Tsunayoshi (1681 to 1709), or Jôkenin according to his posthumous name. Gold lacquer articles (small chests, boxes, writing utensils, etc.) of this time are veritable masterpieces in the making of which a workman was often engaged for years, whose ornamentation was performed with surprising patience, care, fineness, and truth to nature, and whose price in our days is correspondingly high, for the great artistic perfection of many pieces is only equalled by the richness of the gold employed in the decorations.

In order to understand this period and its industry correctly, we must call to mind how at this time the country was almost entirely shut up and thrown back upon itself; how firmly grounded, fearing no foe, was the rule of the Tokugawa Shôguns. Thus Iyeyasu's successors in Yeddo were able to give themselves over undisturbed to the refined enjoyments of life, and as the treasures of the land were poured in upon them, and Sadô's mines still yielded rich returns of gold and silver, the value of the former reaching four or five times that of the latter, it did not matter how much time nor how large a quantity of the precious metals were used which a fine lacquer work demanded, if only it was satisfactory in other regards.

In proportion as Yeddo, the city of the Tokugawa, from the year 1600 grew in extent, power and appearance, it became more and more the rendezvous of the most skilful lacquer workers. The tomb of the Shôgun Hidetada, in the Mausoleum at Shiba, a part of Tôkio, which dates back to the second quarter of the 17th century, is undoubtedly one of the oldest and most beautiful of the large lacquered products of a high degree of perfection which have come down to us from this time.

With the beginning of the 18th century the Giyô-bu Nashi-ji (see p. 371) was added to the former modes of decoration. It is named after Giyô-bu Tarô, an influential lacquerer in Yeddo, whose method was largely followed. It consisted in laying small squares of gold-foil in places, *e.g.*, on the pictured trunks of trees, a wearisome and costly mode of ornamentation, such as we often see on old Japanese lacquer work, but which we cannot appreciate as thoroughly as the Japanese themselves.

Many of the fine gold lacquer wares of the time of the Tokugawa Shôgun bear the simple arms of this family or of some Daimiô who had ordered them. Among them are the many beautiful little chests, with box-like over-hanging covers. They were used at weddings and other festal occasions for sending presents, and were carried by heavy, elegant silk cords with tassels, which fastened the stiff silk cover which went around the chest and protected it. Highly prized as were the beautiful fabrics, bronzes and fine ceramics, the old prosperous families seem to have valued nothing so much, next to their swords, as a fine piece of lacquer work from the hand of a recognised master.

As the old order of things in Japan was broken up, Shôguns and Daimiôs lost their power, and many beautiful specimens of industrial art which had hitherto been treated to a certain extent as heir-looms, and had been exhibited and admired with pride and pleasure, were neglected and trifled away, and a large number of the old and valuable lacquered articles came into the hands of traders and strangers. Their price at that time (1868–1870) is said to have been so low as to justify the often repeated expression of the seller, that it would be more profitable to burn them and to collect and sell the gold used in making them.

In order to supply the export of Japanese lacquer wares, which has increased each year since then, and the home demand also, in which the much used vehicles, Jin-riki-shas, figure prominently, the increasing competition sought above all quick and cheap labour on the part of the lacquerer. His talent seemed directed only to this want, and the invention of new forms for knick-knacks and useful articles of all kinds, and to become educated in this direction only.

The foreign friend and connoisseur of Japanese lacquer work, said rightly, in considering these indications, " Here disappears an illustrious feature from the past of Japan, for it will not be long before the last competent Makiye-shi of the country has passed away, the last who understood how to create with his brush, in the old way, real works of art. Then there will remain only the ordinary manufacture for the daily market, that is to say, only a weak copy of the former artistic ability and accomplishments.[1] It is high time therefore, to buy up and to save for our own collections the still remaining products of ancient art."[2] But lo, with this tendency and the impulse which the great International Exhibitions extended to Japan, the price of fine gold lacquer work rose anew. The really artistic lacquer productions were once more made to pay, and the result is that to-day there are Makiye-shi in Japan whose works may be placed side by side with the best of earlier times.

[1] Wagener says appropriately, in the repeatedly quoted article on Japanese lacquer wares, that there are the same grades here as between a child's picture book and a miniature painting from a master hand, and that the more often a connoisseur beholds a really beautiful specimen of Japanese lacquer work, the greater will be his pleasure in the art.

[2] The Frenchman Watlin remarked already in 1773, in his work on the lacquer art : " These Asiatic nations (Chinese and Japanese) no longer work so diligently and finely since, full of astonishment at our foolish fancies, they cannot furnish the ready made articles fast enough to satisfy our insatiable desires. They work more carelessly in order to increase the quantity. The amateurs therefore also make a great difference between the old and the new lacquer."

At the last Paris Industrial Exhibition in 1878, one article, a lacquered three-winged screen (biobu), was prominent above all the other Japanese lacquer wares for the richness and elegance of its decorations—an exhibition piece, that even in the presence of the shields of Elkington, the bronzes of Barbedienne, and the beautiful Indian collection of the Prince of Wales, made a great impression on the lovers of art. This master piece, on which, I was told, workmen were employed two full years in Tôkio, showed beyond a doubt, that the old lacquer art is still well understood, when time and means are richly furnished for carrying it out. A more beautiful ornamentation in raised gold lacquer work is scarcely conceivable than the magnificently executed red and white pæony blossoms in gold and silver, the several chrysanthemums and other flowers with their leaves, which adorned this screen. The Prize Commissioners rewarded the exhibitor, Minoda Chojiro, a merchant of Tôkio, with the gold medal, and an English amateur paid the sum of 60,000 frcs. for it.

Whoever has followed the progress of this industry since that time, and has noted its products in those shops in London, Paris, and Berlin, which have made it their specialty to collect and sell the better class of Japanese products of art industry, must indeed have been convinced that the endeavours and progress in this branch have not been limited to the great universal exhibitions, and cannot fail of receiving wider recognition on the part of purchasers.

The lacquer industry of to-day is concentrated principally in and around Tôkio, and the greatest export of its wares is by way of Yokohama. Most of the lacquer wares of Shidzuoka and the northern provincial cities, Wakamatsu, Yonezawa, Niigata and Noshiro are sent to this point. Shidzuoka and Niigata furnish among other things great part of the favourite oval bread baskets, made from magnolia wood, with or without the rattan covering. In Niigata not less than 200 families were supported, in 1874, by the lacquer industry.

In the valley of the upper Sai-gawa and of the Kiso-gawa, in the province of Shinano, along the Nakasendô, the towns Hirasawa, Nagai, Yabuhara and Fukushima manufacture a large amount of cheap wooden lacquer wares for the home market, chiefly soup bowls and other wooden dishes. Instead of using Kokuso-kau, the joints are painted over with a mixture of wheat flour and Se-shime-urushi. Wakayama and Kiôto provide the market of Ôsaka and Hioga principally. At Nagoya the lacquer decoration is worked mainly upon pottery (porcelain and earthenware), in Kiôto on bronze and copper. Nagasaki furnishes tortoise-shell work principally, and imitations, with some very fine gold lacquer decorations. Cabinets and other articles inlaid with mother-of-pearl are also sent largely from here, and the lacquered Arita vases with the wavy border.

4. Textile Industry.

Hemp, Linen and Muslin.—Banana Fabrics.—Cotton Industry.—Principal Works, Places and Chief Notable Products of Silk Weaving.—Auxiliaries thereto.—Habutai, Crape; Kanoko, Brocade.—Use of Gold and Silver Paper in Brocade.—Velvet Weaving.—Embroidery.

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In this department the animal raw-material to be considered is chiefly silk; in vegetable fibres, cotton principally, and hemp, besides Böhmeria bast. The last two are a substitute for flax. Their woven tissues are simple, without pattern, and some of them are very fine. Nara Jôfu, hemp linen (Asa-nuno), from the old city of Nara in the province of Yamato has a high reputation. It has been already mentioned (p. 165) that hemp is the oldest cultivated texile plant of Japan, and that the most common clothing of the country people is made of a coarse hemp fabric, coloured blue with indigo.

Echigo Jôfu is a sort of muslin, the linen made from the fibres of the Nettle hemp, Kara-mushi (*Boehmeria nivea*) from Echigo. It is bleached on the snow, and is not inferior in appearance to the finest hemp linen. A fabric is made by using a strong twisted thread for the woof, which under the influence of steam or a bath crinkles like crape silk (which see). This is called Echigo Jôfu Chijimi, which when bleached to simple white or printed in indigo and other colours, furnishes a popular material for light and cool summer clothing, and is much more durable than calico. The Bashô-fu or banana fabric of the Riukiu islands has been sufficiently described on p. 168.

The manufacture and use of cotton materials (Jap. Momen-mono), as well as cotton cultivation, have been promoted since 1600 A.D., first under the Shôgunate of Tokugawa. The summer clothing of the more prosperous classes and of the inhabitants of cities generally, has been from that time mainly of cotton. The spinning and weaving of cotton, however, has never advanced beyond the stage of a house industry, and never supplied more than the domestic need. This is the case also in the cities of the provinces of Kawachi and Harima, especially of Sakai and Himeji, which have the largest cotton industry. The Riukiu Islands furnish cotton materials, usually white checks on a blue ground, which are very popular on account of their strength and durability. The looms at Morioka in the North supply a considerable part of the demand, but get their raw material from the southern provinces. A cotton stuff from Narumi in the province of Owari, and called Narumi-shibori is very celebrated. The dyeing of this fabric is similar to that of Kanoko-shibori (which see), and many houses at Arimatsu, a pretty village on the Tôkaidô, deal in it. The industry has accomplished all that was possible with the old looms and other appliances, but with the opening of the country to foreign competition, can scarcely keep its position.

However notable the performances of the nations belonging to the Chinese system of civilization have been in the working up of the before-mentioned and other vegetable textile stuffs, they have never expended upon them any real art.

It was in the nature of things that the silk manufacture should have reached a far higher degree of perfection. The excellence and remarkable fitness of the material for artistic treatment, and the many centuries of effort had so operated, that even in the Middle Ages, *e.g.*, in Marco Polo's time, the Chinese could furnish silk velvet, brocade, and other fine fabrics at moderately cheap prices, not only to Western Asia, but also to the districts near thereto.

We read for instance, in the work of Antonio de Morga,[1] that the Chinese junks which came in the spring with the then ruling north-western monsoon, from Macao, Canton, and other ports to Manila, brought "raw silk, velvet, plain and also embroidered in various patterns, silk brocade of many colours and patterns, and ornamented with gold and silver (all the gold threads, however, were of paper and spurious), damask, satin, taffetas, etc."

Even more interesting is an item from Linschoten,[2] which expressly states that the Portuguese got silver from Japan in exchange for silk wares, which they brought from Macao, although at the time of the conquest of Malacca (1511 A.D.) by Albuquerque, according to a note made by the son of this Portuguese general, the Gorés (Japanese ?) brought already silk and brocade among other things to Malacca.[3]

The apparent discrepancy between these two statements is

[1] "The Philippine Islands, Moluccas, Siam, Cambodia, Japan and China at the close of the sixteenth century, by A. de Morga." London: Hakluyt Soc. 1868, p. 337 ff.

[2] "The voyage of J. H. van Linschoten to the East Indies, etc., from the old English translation of 1598, by A. Burnell." Hakluyt Society, 1875, p. 147 ff.

[3] Crawford: "Descriptive Dictionary of the Malay Archipelago," p. 164.

not difficult to reconcile. As appears from the previous observations concerning silk culture in Japan (observations also true of silk industry), it is limited to Hondo, the principal island. It was so always, undoubtedly. It is therefore easy to believe that in the 12th century this island exported silk stuffs, while the island of Kiushiu, with which the Portuguese had to do, almost exclusively received them during the latter part of the 16th century from China viâ Macao, not to mention the fact that internal wars and dissensions in the capital Kiôto might sometimes check the exportation of silk to the southern islands ; so that Nagasaki was probably more easily supplied with stuff from China than from the manufacturing and commercial cities of Hondo. Be this as it may, however, the fact remains that those Europeans who were particularly interested, in 1859, when the export of Japanese silk began, had no idea of the high standard to which the Japanese silk industry had reached. Nevertheless, as in China, so also in Japan, silk weaving had been for several centuries one of the finest examples of artistic excellence. It shows to-day, also, what high development an industry can attain, even with imperfect working appliances, in the hands of an artistic, skilful, and persevering people. Up to 1859, the silk culture and silk manufacture of the country supplied nothing more than the domestic trade. Thunberg thinks the reason that the fabrics did not reach European markets, was solely owing to their narrow width.[1]

When at the Vienna Exhibition of 1873, Japan for the first time displayed the variety, richness, and tasteful collection of its Kinu, or silk factories, not only were the ordinary visitors astonished at these unsuspected accomplishments, but even more the well-informed Prize Commissioners. There were simple, smooth stuffs, and surprisingly beautiful twilled fabrics full of softness and elegance, with heavy brocades and other figured materials of a beauty utterly unanticipated, besides some entirely new appliances and designs. Though, it is true, the Chinese were the teachers and models to the Japanese in silk manufactures, yet here, as in so many other instances, the pupil has outstripped the master. There is no better recognition of the work of Japanese silk weaving than the judgment of the competent Prize Commissioner of the Vienna Exhibition, Al. Heimendahl, the President of the Crefeld Chamber of Commerce. He writes in his Report on Silk and Silk Wares as follows: "However much one may be inclined to shake the head at much that is burlesque and *bizarre* in design, and at the peculiar tendencies of style, all that is not beautiful is ennobled by one common feature, everywhere to be seen—pleasure and perseverance in work. But besides these noted eccentricities there is, on the other hand, such a fine sense of form and colour, whether it be manifest in

[1] "Silkens handelen blomstrar väl innom Riket, men för den smalhet, som tygerne här äga kunna de icke utföras och af Europeérne nytjas."—Thunberg : Resa uti Europa, Africa, Asia, iv. p. 105. Upsala, 1793.

materials of the softest shading, or the most spirited designs ; in ornaments of mingled gold and silver which do not so much imitate nature as use her suggestions for new and fantastic forms—that they excel anything brought to the Exhibition from European art looms."

While the silk culture of Japan received a great impulse at the opening of the new commerce and the restoration of Mikado-rule, silk manufacture has been much and variously damaged thereby. The cheap cotton and wool stuffs thrown upon the market from foreign countries for several decades, compete constantly more strongly with silk materials. Most of the velvet looms were obliged fifteen years ago to suspend competition with the extraordinarily cheap cotton velvets of Manchester. And it has come about that the export of raw silk, beginning in 1859 and rapidly increasing in succeeding years, to which that of silkworm eggs was soon added, has had a great influence on the price of raw silk, which has risen within a few years to ten or sixteen-fold. Many of the Japanese, under such circumstances, found themselves obliged to give up their custom of wearing silk clothing, and to use the much cheaper woollen and cotton material.

Japanese silk industry on the other hand, with all its fine products, could not gain new markets of any consequence, for the change from hand to machine weaving has not yet taken place with them. They still work after their old fashion with hand-looms, such as were used in Europe a hundred years ago. Even the change from narrow breadths, especially in smooth fabrics, of 34 to 45 centimeters, to the greater widths common in Europe has been accomplished but slowly, and is not even yet at all universal. After the steam loom had begun to revolutionize the silk industry in Europe, there could be no more Japanese competition.[1] Not until the example of Europe in this respect is followed will the cheaper labour power and greater skill and aptitude avail to put the Japanese on a new basis of competition with foreign countries in its silk industry. And that, of course, opens to house industry no very inviting future. As the Filanda founded at Tomiôka in 1872 with its steam power rendered the small reeling establishments, which could no longer compete with it, gradually useless, hundreds of web looms and those dependent upon them will be concerned in the new manner of silk manufacture.

Kiôto takes now, as for many centuries past, the first place in Japanese silk industry, with her figured silks of all kinds, especially gold wrought brocades, rich with flowers and other ornaments, her figured damasks and crapes, reps, velvet, and other beautiful fabrics. The weaving and dyeing establishments are located in the western part of the city known as Nishi-jin, *i.e.*, " West barracks," and are constantly increasing. According to Bavier, there are 1,800 silk

[1] The Taiping Revolution gave silk weaving in China as well as art industry of all kinds a shock from which the country has never fully recovered. Since 1854, the export has in no year reached its former amount.

weavers in Kiôto and vicinity, and about 6,000 looms with a product in raw silk of 6,000 bales of 50 kilogrammes each. The value of the fabric manufactured from this is placed at 20,000,000 yen, or over £3,921,568. The silk weavers form free corporations, according to their special employments, for improvement of their common concerns. There is for example a Moyo-sha, or picture-weaving guild, from which have branched off the Kin-ran-sha, or silk-brocade guild, and the Tsuzure-sha for inlaid brocade work. Kiôto has also a Chirimen-sha, or crape guild; and from it have separated the Kanoko-sha, also a Habutai-sha, a Shaori-sha or gauze-weavers' guild, a Natsu-gi-sha or guild for manufacturers of summer goods, a Birôdo-sha or velvet-weavers' guild, and several more. Besides the old domestic dye-stuffs (see pages 175–182) the European aniline dyes are used more and more, also other products of our chemical colour industry, and so successfully too that it is thought in Japan that Kiôto water (of the Kamo-gawa) assimilates them as no others, therefore the Kiôto dyers cannot be equalled.

The sale of Kiôto silk wares and those of other cities is carried on principally at Ôsaka, although in this as in trade generally Tôkio competes with it very strongly. The most extensive silk warehouses are, however, in Ôsaka, old well-known houses that employ from 80–100 Bantôs (clerks), and carry on a very large business.

Kiriû, a little city in the province of Jôshiu (Kôdzuke) east of Mayebashi, near the boundary of Shimotzuke, has next to Kiôto the most important silk manufacture. Like many other places in the province, particularly Mayebashi, Takasaki, and Isesaki, Kiriû, is distinguished mainly for its Shusu (satin), and other simple, light silk fabrics and half-silk materials, of which it manufactures more than Kiôto. It has also an important crape manufacture, and furnishes besides several sorts of Obi, or ladies' sashes. Chirimen or crape silk is made principally, besides here and at Kiôto,—

At Tanabe and Miatsu	in the province of		Tango.
„ Nagahama on the Biwa Lake	„	„	„ Ômi.
„ Kano and Gifu	„	„	„ Mino.

The broad Obi, or sashes for women and girls, are woven in specially fine qualities—

At Hakata	in the province of	Chikuzen on Kiushiu.	
„ Yonezawa	„	„	„ Uzen.

and in the before-mentioned Kiriû. Besides these, Fukushima in Iwashiro, Sendai in Rikuzen, Akita in Ugo, Kôfu in Kôshiu, Kanazawa in Kaga, Hachiôji in Musashi, and even Tôkio the capital, carry on silk industries of a particular kind; Akita for instance, a many-striped Tsumugi, a strong fabric from spun silk waste, whose full name is Kudzu-ito-tsumugi.

Between silk culture, which properly ends with the delivery of the dead cocoons at the reeling establishment (when the cultivator does not himself manage the reeling), and the manufacture, is the silk spinner. He works up the silk waste into flurt or floss silk, which is of great importance in the manufacture of velvet, and the grège or reeled silk into organsin and trame, warp and woof threads. In this the doubling and twisting machines are used, which the French call *moulins* and therefore designate often the entire preparation of reeled silk for its several purposes, *moulinage*, by which the thread acquires the necessary evenness, strength and durability.

In reeling off the thread of the cocoons, from 3 to 15 (in Japan usually 8 to 13) threads are spun together in a *grège* thread according to the size (the *titre*) of the Ki-ito or raw silk that may be desired. To make the strong Yama-mai thread from 5 to 6 cocoons are generally taken in reeling. Usually the organsine threads, for which the best reeled silk is used, have a double twisting, and are therefore dull compared with the woof threads, as in all smooth lustrous fabrics. With crape it is just the reverse. Here the warp, Jap. Tate, is smooth and less twisted and the cross threads, Jap. Yoko-ito, or woof threads, Jap. Naki-ito on the other hand are doubly twisted and dull. In weaving smooth, even or twilled fabrics like Shusu (satin), Nanako (taffeta), Sha and Rô (varieties of floss silk), Tsumugi (waste material), the old handlooms or Hata are used in Japan and the simbolt loom in making figured silks or Mon-ginu. This latter has essentially the same arrangement as was universal in Europe before the introduction of the Jacquard looms in damask weaving. The double facing or the interchange (raising and dropping) of the groups of warp threads known as bobbins, is managed by a drawboy sitting overhead on a board. Many sorts of figures are wrought with this variety of the common handloom. Bavier gives a very good representation of it in Plate IV. fig. 2 of his book, but it is especially adapted to the manufacture of figured satin, crape and brocade.

It remains still to discuss more minutely those products of Japanese silk industry which differ essentially from the European, or are distinguished by remarkable beauty and quality.

Habutaye (pronounced Habutai) or Kabe-habutai, a peculiar ribbed white silk fabric is one of the most magnificent plain silks that Japan can show. It is wavy in texture, a medium between crape and reps. Both warp and woof are much thicker than in smooth and twilled stuffs, and the woof threads are loose and peculiarly twisted. One thin thread of two strands winds in long spirals about a thicker thread consisting of 6 raw-silk strands. This produces not only the peculiar wavy ribbing of the silk, but also its greater fulness and pliancy. In its thickness and softness Habutai resembles velvet, from which it is entirely different in other respects.

bound fast underneath with several windings of hemp thread. This knotting of Kanoko-chirimen is a tedious, unpaying process, falling usually to old women and children. When the under-binding is finished, then follows the bath, and dyeing, drying and stretching of the deeply wrinkled material. The threads used for under-binding become free and are pulled out, and the under-bound spots make a white pattern on the Turkish red, peach-blossom or violet ground.

The Obi, or girdles with which Japanese ladies fasten their long garments (Kimono) at the waist, are made on particular looms, from the finest silk. They are varied in appearance; sometimes smooth, sometimes ribbed figured fabrics 16 to 24 centimeters broad, and 3 or 4½ meters in length, so that they may be tied in bows at the back. The finest are the Hakata-obi, but the Koyanagi-obi also in thick satin from Kiriû, the ribbed Donsu-obi from Yonezawa and several others are highly prized.

Garments of brocade, Jap. Nishiki, *i.e.* heavy fringed silk inwrought with gold and silver, the richest and costliest which textile industry in general can furnish, have always been used for ceremonial garments by Chinese and Japanese princes, and for the furnishings of the richer theatres and temples. In Kiôto the brocade manufacture has stood from the beginning under the special protection of the reigning Mikado, and that it has maintained itself in full strength to this time, in spite of unfavourable conditions, is due at least in part to the constant imperial protection and encouragement.

When in 1868 Prince Arisugawa undertook the chief command against the "Eastern Rebels" (adherents of the Tokugawa dynasty), he received from the Mikado the brocade banner and sword, as tokens of the imperial power and cause. After the entry into Yeddo, every Samurai sewed a brocade stripe on his Kimono (coat), over which the inhabitants of the capital of the Tokugawa made merry, calling them the imperial Kingiré or brocade rags.

The high estimation of brocade is manifested also in several proverbial expressions, *e.g.*: "Kokiô ye Nishiki," *i.e.*, "Clothe yourself in brocade when you return home;" the sense of which is; "Return not homeward till you have gained something for yourself in the foreign land." This is more beautiful: "Tzuzure wo kite mo kokoro wa Nishiki," or "He wears rags, it is true, but his heart is of brocade."

There are two kinds of brocade in Kiôto—Ito-nishike, gold-thread brocade, and Aya-nishiki, silk damask brocade, or brocade inwrought with flowers. A beautiful piece of the former, 44 centimeters broad, and 5·454 meters long, designed for the Mikado, was said to cost 30 yen or over £6; another of the same width and 11·5 meters long, 45 yen, about £9; and for a third, 71 centimeters long and 8·5 centimeters broad, 50 yen, or £10, was offered.

The use of gold and silver paper in the Japanese brocades has

Brocade Pattern from Kioto.

Wilhelm Engelmann, Leipzig.

awakened great interest with European silk manufacturers. The paper is cut into narrow strips and is then either spun around silk thread or is itself twisted into a thread, and woven in. The fabrics in this way look just as if they were inwrought with genuine gold and silver threads, but differ in that they are cheaper and more flexible.

To make Kin-gami or gold paper, Usude-Torinoko-gami, a Gampi or Kôdzo paper (see Paper Industry) is painted over on one side with a mixture of raw lacquer (Ki-urushi) and sulphur (Iwo), and rubbed smooth with paper balls or pillows, when it is overlaid with genuine gold-foil (Kin-paku) and then the entire gold covering is rubbed over with loose cotton balls. The Hon-kin-gami, or genuine gold paper, so prepared, can be used immediately after drying. In making Gin-gami or silver paper, the sulphur must of course be left out. This is prepared with Shôfu or wheat-flour paste instead of lacquer, and then overlaid with Gin-paku, or silver-foil. An imitation is made with tin-foil (Shari or Sudzu-haku) which is fastened to the paper with Shôfu. Silver and tin-foil are also used to imitate genuine gold paper, receiving a coating of colour for this purpose. Such a coating is prepared by the aid of a yellow solution and glue-water, through which the white metal underneath appears of a greenish yellow colour with a bright lustre. Other gold-yellow shades are obtained by coating the white metal-foil with a mixture of Shôfu and Beni (carthamine) or Beni-gara (red oxide of iron).

The real and the imitated gold and silver paper prepared in one way or the other, are cut by a machine into narrow strips, Kin-shi and Gin-shi, or gold and silver threads, which are spun with silk or cotton threads. Of course only the real gold or silver paper is used in valuable brocades. In spinning it with silk the thread runs from the little reel of a hanging spindle over a frame. The strip of gold or silver paper is held with the paper side towards the thread and the spindle set in motion, whereby the narrow strip winds itself around the thread and is bound tightly to it. When one strip is wound, another is taken, and so on.[1]

Tzudzu-re-no-nishiki or brocading with short threads. In 1875 Yasuda Mosaburo manufactured in Kiôto a kind of brocade bearing this name, after a peculiar process. Warp and woof consisted of strong, twisted silk and gold-paper threads. The case of the loom was wanting, therefore there was no proper fastening and the cross threads were laid in with the fingers and pushed in with a comb by hand, as was done universally in olden times. The pattern

[1] It may be of interest to know that the Industrial Art Museum in Berlin has not only samples of the several brocades, but also these paper metal threads. The collection contains : Hon-kin-gami, genuine gold paper, and Usu-kin-gami, thin gold paper, Shari-gin-gami, tin-silver paper, Shari-kin-gami, tin-gold paper, also the same with a greenish appearance, and Hon-kin-shi, real gold-paper thread over silk, Iro-hon-kin-shi, gold-silver threads on silk, Iro-kin-shi, tin-foil gold on cotton, Kiri-kin-shi cut tin-gold paper strips, and other samples.

on paper laid under the warp, and the coloured woof threads were chosen accordingly, but did not extend across the entire breadth but only so far as needed by the figure, and the next figures were filled out with other colours before or after. Beautiful table cloths and Fukusa, *i.e.* fabrics for wrapping up and covering presents, for example, fine lacquer-wares and other articles, were manufactured in this way, as well as material for little bags—especially Tabako-ire, for preserving cut tobacco. Their value and price were of course far behind that of the genuine brocades.

We have also to mention the Yûzen-somi. A peculiar art, practised by Hata Zenshiki and others in Kiôto, consisting in painting the pattern on the finished silk fabric. For this purpose, the interstices between the figures of the design are covered with Nori (paste) to protect from capillary attraction and the running of the colours at the edges. The rest of the process is very much like painting on silk in general.

In the manufacture of Birôdo or velvet, nothing was formerly attempted but the plain and the ribbed fabric.[1] The apparatus for making it resembles our earlier velvet looms. The pile of the upper part of the warp is wound around parallel copper sticks or needles. When the fabric is finished, the nap or meshes are cut by a knife running between two jacks, and the needles are taken out. The Japanese velvet manufacture has its seat in Kiôto and Nagahama. In 1874 it was entirely abandoned at Ishida, a place east of the Biwa Lake and not far from Nagahama, because, as one manufacturer told me, the import had so run down the price, and on the other hand the export of raw silk had so increased its value, that it was impossible to manufacture with profit.

Nui-mono or Nui-haku, embroidery, especially with silk on silk or woollen material, is closely connected with silk weaving. It is a highly developed branch of Japanese art industry, in which the ruling traits of Japanese workmen, pleasure and satisfaction in the product of their labour, combined with carefulness, great skill, and admirable taste, are again displayed. By an ingenious alternation and combination of flat embroidery and feather-stitch, sewing on cords and the like, and a wise choice, association, and shading of colours, surprising effects are produced, and a considerable degree of life is communicated to the flowers, birds, butterflies, and other subjects copied by the needle.

Embroidery has been an employment in Japanese houses from ancient times till now. Mothers teach their daughters at an early age to form a pleasing mosaic with different coloured patches, from which they make covers for chopsticks and tooth-picks, battledores for a kind of shuttle-cock game, and other articles. When older, making and adorning of dolls' clothes furnish a large oppor-

[1] During the last few years, they have, however, succeeded in covering ribbed velvet with pictures in different colours and shades, which are real works of art, and at least equal to anything of the kind woven in France.

Verl. v. Wilh. Engelmann, Leipzig
Lith. Anst. v. Werner & Winter, Frankfurt a/M.

EMBROIDERY PATTERN

tunity for further cultivation of skill and taste. Embroidery, however, has not become a means of livelihood among the female population, but in its finest forms has been long the work of men. The ceremonial silk garments, theatre costumes, rich robes of the priests, Fukusa or silk materials for wrapping presents and other articles, all ornamented with Nui-haku, and many other fabrics, are all from the hands of men. In Kiôto, Nagoya and several other cities, they embroider the beautiful panels of screens, pillow covers, table cloths, etc., which have been exported for some time past, and are so justly appreciated in Europe.

If one walks through certain streets of these cities on a summer day, he will see men and boys at work at their embroidery in front of the houses. The silk or woollen material to be embroidered is stretched over a frame, both ends of which are laid on two wooden blocks or some other supports, some 50 or 60 centimeters high, so that the needle may be easily put through from both sides. Birds, flowers, and other things to be copied are designed on a pattern or stitched free hand on the material. Oftentimes this silk embroidery is connected very skilfully with the painting or printing of the material and also with the designs of figured silks, including brocades, and in such case appears as a further decoration in relief.

(Plate VIII. p. 386 represents a brocade pattern, and Plate IX. p. 388 a piece of Japanese embroidery.)

5. Paper Industry.

General Properties of Japanese Paper.—Materials for its Manufacture, and how obtained.—Making and Employment of the Principal Kinds of Japanese Bast-Paper.—Couched Board: Ita-me-gami and Hari-nuki.—Paper Hangings.—Chirimen-gami, or Crape Paper.—Leather Paper, or Kami-kawa.—Shi-fu, or Paper Fabric.—Oil Paper, Waterproof Cloaks, Screens, Lanterns and Fans.—Appendix: Sumi-ire, the Japanese Writing Box and its contents: Brush, Indian Ink, and Ink Dish.

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4. "Kô yeki koku san kô" (pronounced Koëkikosánko), *i.e.* "Observations on the Extension of the Useful Productions of the Country." Vol. viii. By Okura Nagatsume. Ôsaka, 1884. Vols. v. and viii.

5. St. Julien: "Industries de l'Empire Chinois." Paris, 1869. pp. 140–150.

6. "Wiener Ausstellungsberichte über die XI. Gruppe." By R. Weber, E. Twerdy und Andern. 1873.[1]
7. M. Jametel: "L'encre de Chine d'après des documents Chinois." Paris, 1882.

The manifold uses of paper[2] in Japan have been repeatedly mentioned in the old accounts of the country. E. Kaempfer especially, nearly two hundred years ago, observed and described the making and use of this paper so well, that he has not found his equal during the long period of the Dutch trade privilege, and still less in the preceding time of the Portuguese trade with this Orient of the Chinese. If much that he has written is unreliable, it must be attributed chiefly to the circumstances under which he passed two years in Japan, the strict commercial limitations, and the lack of opportunity to enter and inspect the interior of the country.

In modern times, not only every foreigner in Japan, but every visitor at the Universal Exhibitions of Vienna, Philadelphia, and Paris, could easily observe how manifold are the uses of this peculiar material. It serves all the purposes for which we use paper: for book printing and making of wall papers, for writing and packing material,—and in addition to these, it is a substitute for string and cloth, oilcloth and leather, and even wood, iron, and glass. Many of its uses sprang from the lack of proper material, or its light, cheap nature—as for window panes and handkerchiefs, umbrellas and parasols—and will surely, though gradually, pass away under foreign influence. Others are founded on some of its properties, especially the great pliability, firmness, and durability which distinguishes Japanese hand-made paper over our machine-made, and even over our firmer rag-paper, and thus will last as long as it maintains these excellent qualities. These advantages are based on the material and the manner of manufacture, for the Japanese hand-made paper is made of the very tough and pliant inner bark of from three to six species of deciduous trees, which have long, tough fibre cells, and in transforming this into paper pulp it is not cut and hacked, but by pounding and beating is only softened and separated, so that the long cells remain whole.

In this way the Japanese bark paper evinces a surprising toughness and flexibility, and combines the softness of silk paper with the firmness of a woven texture. Like its kindred Tapa of the Polynesians, it occupies a middle place between our smooth, brittle machine paper and a woven fabric, and can in many cases be employed like the latter, but will not withstand moisture. As the felting and twisting of the long, tender fibres is excluded by the

[1] The foundation of the treatise now in hand has been chiefly the Report of the Prussian Minister of Trade, of the 25th of January, 1875, which is based on personal studies and observations.

[2] The Japanese name for paper is Kami, and as an affix to the proper name it is changed into gami, for which the Chinese word shi is often used.

manner of making, and the slimy or gum-like vegetable cements are dissolved in water, its firmness and toughness disappear when it is wet, that is in all cases when the contact with water is not excluded by saturating it with oil or lac.

In the manufacture of the Japanese tub or hand-made paper, the workman holds the form or scoop-net so that the parallel bamboo splinters or threads run from right to left. He lifts and lowers the form in front of him and at right angles to that direction, causing the fibres of the material to move toward this side and lie there. The consequence is that each sheet of Japanese bark paper is torn easily and straight in this one direction, but with difficulty and crooked and with a fuzzy edge in the other. The Japanese knows and observes this fact whenever he tears a strip off for a string, making the rent in the direction of the parallel fibres.

The smoothness, evenness, and firmness of Japanese paper is not effected by special sizing and glazing. Nevertheless each sheet has usually a rough and a smooth side, which are designated Omote and Ura, *i.e.* outer and inner side.[1] These names relate to the process of book printing, in which only the smooth side is printed. The sheet is then so arranged in the middle that the fold comes on the outside, the parallel ends lying one above another in the back, the rough side of both half sheets facing inward, and the printed, smooth side facing outward. The one side becomes smooth, however, in comparison with the other in the drying process. After the prepared and shaped sheet is firm enough, it is pasted up with a large brush against a smooth, planed board, and placed in the air to dry. The side next to the board will naturally be much smoother than the outside, so that in this respect the designations Omote and Ura must be changed in order to make them harmonize with the fact.

The porosity of Japanese paper unfits it, save in exceptional instances, for writing on with pen and ink; but it is well adapted to the Japanese mode of writing with brush and Indian ink, from the top of the page downward and in rows from right to left. The smooth, firm, machine-made paper, so advantageous for our way of writing, would not absorb the Indian ink so well, and so fail in its purpose. In consequence of its porous nature, the pure bark paper absorbs moisture and holds dust more easily than our stiff, smoothed machine paper, with its mineral substances. It is also more open to the depredation of insects. The hygroscopic absorption of water is, however, with ordinary dry keeping never so great as to appreciably injure it.

There is no peculiar process of bleaching in Japan, nor anywhere

[1] German drawing-paper is generally smooth on one side and granulated on the other, as is the beautiful hand-made paper of J. W. Zanders in Bergisch-Gladbach. The English drawing-paper is like German writing-paper, smooth on both sides, while the French Torchon on the other hand is particularly thick, and granulated on both sides.

else in Eastern Asia, or in the Himalayas, where bark-paper is made. It has always therefore a yellow tint, varying according as the raw material may be whitened or not by the water and other ingredients used in the manufacture for softening it.

According to Grosier,[1] Chinese historians report that the art of paper-making was invented in China about 105 A.D., by Tsai-lun. Previous to this, the Chinese wrote on tissues of hemp and silk, on bamboo tablets and palm leaves; and in Farther India palm leaves are still used in this way. The leaves of the palmyra palm (*Borassus flabelliformis*) especially serve this purpose in the Malay Archipelago, where, as in the South Sea Islands, the manufacture of paper, says Crawford,[2] remains unknown even to the latest times.

The Chinese make paper out of the pith of the Aralia papyrifera from Formosa, which is the so-called rice-paper, and from young bamboo cane, rice and wheat straw, rushes, cotton, hemp, and the inner bark of several plants, especially the paper mulberry. They also work up old paper into new of an inferior kind, as do also the Japanese. It is said by Grosier that the people of a whole village in the vicinity of Peking support themselves by collecting and cleaning waste paper. In Southern China, the brittle paper made from bamboo, the pith of Aralia, and straw is most manufactured and used; in the North principally the stronger bark-paper, although the production does not suffice for the great demand for window panes, packing paper, and other things, so that much is imported from Corea.

The art of making paper from the bark of different trees was brought from Corea to Japan about 610 A.D., and some say still earlier. Owing to the manifold uses of paper in Japan, the manufacture gradually became one of the most important and extended branches of industry, with which the cultivation of shrubs which furnished raw material, the paper mulberry and three-forks (*Edgeworthia*) went hand-in-hand.

Paper and its manufactured products have been used in the countries of Chinese civilization, and especially in Japan, since the earliest times, not only for writing, painting, printing, packing, handkerchiefs, and other detersives, but also for fans, screens, umbrellas and parasols, lanterns, doll's clothes, waterproof cloaks and head coverings, tobacco bags, cases and boxes, and for window-panes instead of glass, the beautifully made lattices of the sliding doors being covered with it. It serves also for making a strong thread which is used for binding instead of cord and straw rope, as well as for the woof of light cool fabrics, and, covered with gold and silver, for the fine ornamentation of costly brocades. The

[1] Grosier: "La Chine." Vol. vii. p. 120.

[2] "The art of making a true paper from fibrous matter reduced to a pulp in water, has never been known in, or introduced into, any of the Indian Islands."—Crawford: Descriptive Dictionary of the Indian Islands. London, 1856, p. 327.

hat of the Samurai was made of black lacquered paper, the waterproof cloak of his servant and companion of oiled paper, and the hair ornament substituted by poor girls for the silk kanoko, was a paper made to look like crape.[1]

Raw Materials for Japanese Paper Making.

For hand-made or tub paper are used: (1) the inner bark of *Broussonetia papyrifera;* (2) of *Edgeworthia papyrifera;* (3) of *Wickstroemia canescens;* (4) of *Morus alba;* (5) of *Aphananthe aspera;* (6) exceptionally of *Cannabis sativa, Boehmeria platanifolia, Wistaria chinensis* and several other plants, also cotton; (7) straw; (8) old paper. As cement was used: (1) the mucilaginous root of *Hibiscus Manihot;* (2) the bast mucilage of *Hydrangea paniculata;* (3) of *Katsura japonica;* (4) Rice paste.[2]

1. *Broussonetia papyrifera*, Vent. (*Morus papyrifera*, L.) Family Moreæ, the paper mulberry tree, Jap. Kôdzo (also Kózo-no-ki, Kôzo, Kago, Kaji, Kaji-no-ki, according to the district). This most important plant in the paper industry, since the strongest and greatest amount of paper is made from its bark,[3] comes from China,[4] but has been cultivated for a long time in all the provinces of Japan south of the Tsugaru Straits, except on the fertile plains. It is found in mountain valleys, along the roads, on the narrow ridges which separate the terraced rice-fields from each other, on river dams, where its bushes, as willows with us, help to make them firm, it is also cultivated in dry fields, not seldom alternating in rows with the white mulberry or tea bush. In Iyo, on the island of Shikoku, where the paper mulberry, just as in the neighbouring province of Tosa, is raised frequently on the hill sides, it appears as an undergrowth between the rows of sumachs. Only rarely does one find a piece of good arable land exclusively devoted to a plantation of Broussonetia bushes. I speak here of bushes, and

[1] Kublai Khan had paper money made in Peking about, 1260 A.D., the time when paper was first known in Europe.

[2] In the paper industry of Europe, the use of vegetable pasting materials has been more and more adopted during the last fifteen years, superseding the animal glue. In Eastern Asia and India it is as old as the industry itself.

[3] Although this great importance of the paper mulberry in the paper industry of Japan has been thoroughly emphasized by Kaempfer and Thunberg, we find in the otherwise very readable official report of the Vienna Exhibition (Group XI.), the opinion of the engineer and paper manufacturer, E. Twerdy, that the fibre of the China grass (*Urtica nivea*) is most likely chiefly used in the manufacture of Japanese bark paper.

[4] It is well known that this plant is extensively found in Polynesia also. Its bark furnishes still the clothing material of the people in the Fiji Islands, Samoa, Tonga, Tahiti, Hawaii, etc., viz. the Tapa, which can only be worn in dry weather. "The measured noise of the Tapa clapper is as characteristic and as tuneful in the Fiji villages, as the noise of the threshing in ours in the autumn."—M. Buchner, "Reise durch den Stillen Ocean," 1878.

emphasize the fact that I met the plant as a tree in Japan only in the rarest instance, *e.g.* in the Botanical Garden. Its cultivation for the paper industry resembles our treatment of basket willows. Its propagation is by means of slips. Every autumn, after the leaves have fallen, the young shoots near the ground are cut off, and in this way, after three or four years, bushes with from 4 to 7 one-year shoots are obtained. From the fourth year after planting, onward, these reach a height of from 1 to 3 meters and a circumference of 4 centimeters, and are now ready to be used for paper. The bark does not entirely ripen till after the leaves have fallen, the harvest, therefore, does not usually come before November, after that of rice and other field products.

The collected shoots of the paper mulberry are cut into lengths of 1 meter, and bound together in small fagots, then placed in a covered iron kettle of boiling water, to which some ashes have been added, and left till the bark is easily loosened. When it is separated from the wood, the bark is washed in running water, then dried in the air and brought to market. In many cases, the operation is carried a step further, and the epidermis with the still green parts of the bark is removed and serves, together with the unripe bark of the tips of the shoot, to make an inferior paper, the Chiri-gami (rubbish paper). The outer skin and green parts of the bark loosen themselves first, and with a blunt knife are easily scraped away from the white fibre, if the bark has had a thorough maceration in running water. A longer or shorter bleaching of the bast in the sun is often added, but is not at all universally practised.

The provinces of Iyo and Tosa on the island of Shikoku furnish the greatest amount of Kôzo bark, for which the city of Ôsaka is the chief market. One hundred kilogrammes of raw Broussonetia bark yield 45 kg. of white bast.

The Japanese, according to the colour and thickness of the bark and form of the leaves, distinguish many varieties of Kôdzo, to which those classified in Miquel's "Prolusio Floræ Japonicæ" and in the "Enumeratio Plantarum" of Franchet and Savatier as independent species belong, viz. *Broussonetia Kasinoki*, Sieb., and *B. Kaempferi*, Sieb. The typical and most widely distributed form has generally symmetrical three or five-lobed leaves whose underside is covered, like the stems of 5 or 6 centimeters length and the young branches, with a thick, greyish white down, and whose edges are serrated. The bark of the one-year old shoot is reddish brown. Plate X. has a well outlined picture of such a paper-mulberry bush, as it appears in midsummer. The illustration is taken from the fifth part of the Japanese work Kô-yeki-koku sanôk, and is only unreliable in this, that it does not show the serration of the leaves. In Plate XI., is a wood-cut prepared in Tôkio of a variety of the paper mulberry on pure bast paper of the diœcious plant. On the left is a twig and on the right a catkin not fully developed.

BROUSSONETIA PAPYRIFERA VENT. FROM A JAPANESE WOODCUT.

[Page 470.

This illustration together with Plate X. shows great difference in the leaves, concerning which a Japanese proverb says, that no two are just alike. The transformation from the three or five-lobed leaf-form of the younger shoots into the unsymmetrical one-sided and lobed, and then into the undivided oval leaves of the older plants, is but faintly delineated in this plate.

The paper-mulberry tree was introduced into Europe as early as the middle of the last century, and has found a moderately extensive cultivation as an ornamental plant, especially in Mediterranean countries. In the milder parts of Germany, *e.g.*, on the Rhine and Main, it has been long domesticated. It does not endure the cold of a severe winter. A plantation which I made on a piece of good fertile land near Marburg, throve excellently. The tallest shoots by the second summer (1877) reached a height of 1·5 to 1·6 meters, and a circumference of 7 centimeters. Then came the severe cold of the winter of 1879–80 and killed the bushes down to the roots. Attempts at planting the paper mulberry on some railroad embankments around Frankfort on the Main failed, because of the poor quality and dryness of the soil.

2. *Edgeworthia papyrifer*, S. and Z. (*E. chrysantha*, Lindl.), family Thymelæaceæ. The Japanese name for this plant (see Plate XII.) Mitsu-mata, *i.e.* "the three forks," is very descriptive. It has reference to the characteristic trichotomous articulation of the branches, a division which is seen even in the tips of the stronger one-year old seedlings, but is not fully developed till during the second season.

According to the rule of the Japanese peasant, the seeds should be kept dry for a summer and winter, and planted at the beginning of April, or ten days after Higan (the spring equinox). It is sown in rows and the young trees are treated, like most other field growths, with liquid manure. They reach a height of one-third to a half meter by the end of summer, and are transplanted the following spring, and cultivated from that time like the common paper-mulberry bush. The bushes of the Mitsu-mata have more branches however than the former, although the shoots never grow more than two meters high, usually falling far behind this, and are not so thick; they differ from Kôdzo bushes also at first glance in the prettier light green colour of their laurel-shaped, undivided leaves.

The same is true of Edgeworthia as of the Lycoris belonging to the family of Amaryllideæ, of which the Japanese say, "Ha mizu hana miru," *i.e.* "The flowers do not see the leaves." The flowering season falls in March in Middle Hondo, but in the South a month earlier. The seeds ripen during the beginning of May, before the leaves have come fully forth.

The cultivation and use of this Indian plant are much more limited than those of the Broussonetia. If the soil is good and well tilled, the year-old shoots can be used for bast and paper within three or four years after sowing. They are cut in November or December and further treated like those of Broussonetia.

Mitsu-mata is found mostly in the provinces of Suruga, Kai, and Idzu, and within a wide circle around Fuji-san, where a great deal of paper is manufactured ; and at Ishikawa in Kai, Karasawa, and other places on the Tôkaidô ; at Atami in Idzu, *e.g.*, the celebrated Suruga-banshi, a sample of which is shown in Plate XII. Here high mountains protect the Mitsu-mata plantations from the rough winds of winter. In other parts of the country they are more scattered, and appear also as ornamental plants in gardens. In colder districts the young plants must be covered to protect them from the cold of the nights. When von Siebold said that the Edgeworthia is of spontaneous growth in Japan, he was as surely deceived as when he stated that it will accommodate itself to our climate.

3. *Wickstroemia canescens*, Meisn. (*Passerina Gampi*, S. and Z.), family of the Thymelæaceæ. The Gampi plant is a small bush, related to our spurge laurel (*Daphne Mezereum*, L.). It is widely distributed in the mountain forests of the middle and southern parts of the country, though not often meeting the eye, and here in June develops its insignificant reddish brown flowers on the tips of the branches, as appears in the woodcut in Plate XIII. I found it usually from 300 to 600 meters elevation above the sea, as in Miño and Ise. Gampi is not cultivated. In preparing it for paper the bark is stripped off from the slender branches during the summer, just where it grows, is dried and brought to market, or used in the vicinity. In Makidani-mura, province of Mino, the prices of Gampi and Kôdzo were as follows in the summer of 1874:

3 Kuwanme or 11·193 kg. clean Gampi bark, 1 yen or 4 shillings.
2 „ or 7·462 „ „ Kôdzo „ 2 „ or 8 „

The bark of the paper mulberry, which grows also in the neighbourhood, was three times as dear as the Gampi.[1] This last is used by itself (for Gampi paper or Gampi-shi, Plate XIII.), or mixed with Kôdzo, bark material in making paper.[2]

4. *Morus alba*, L., Fam. Moreæ. The white mulberry tree (see p. 193), Jap. Kuwa, furnishes a bark, the Kuwa-no-kawa from which the Kuwa-shi or mulberry paper in Ichikawa, (province of Kôshiu),

[1] Dry Mitsu-mata bark is still cheaper than Gampi. During the same summer 30 Kuwanme or 111·93 kg. (a common horse-load) of the former was sold for 7·5 yen, or 30 shillings, so that its price is to that of the paper mulberry as 1:4.

[2] Several of the bushes of the Himalayan countries are nearly related to the Gampi, and likewise supply the inhabitants with paper. The art of making it is said to have come from Lhassa, to which the Chinese brought the process. A well-known paper in Hindustan called "the Nepalese," is made in Nepal from the bast of the "Sitabharua" (*Daphne canabina*, Wall.). *Daphne oleoides*, Wall., and *D. papyracea*, Wall., serve the same purpose.

Edgeworthia Papyrifera, S. & L..

Japanese Woodcut Printed on Bast Paper made from the same in Japan.

Edgeworthia Papyrifera, S. & L.

Japanese Woodcut Printed on Bast Paper made from the same in Japan.

Wickstrœmia Canescens, Meisn.

Japanese Woodcut Printed on Bast Paper made from the same in Japan.

Plate XIII.

Wickstrœmia Canescens, Meisn.

Japanese Woodcut Printed on Bast Paper made from the same in Japan.

is made. It is almost as strong as Broussonetia paper, but does not possess its fineness and evenness, and therefore is not as suitable when these qualities are especially necessary. It affords, however, a very fine packing material.[1]

5. *Aphananthe aspera*, Planch (*Homoiceltis aspera*, Bl., *Prunus aspera*, Thunb.), Fam. Ulmaceæ. The Japanese call this plant (tree and bush) Muku or Muku-no-ki (see p. 246). The rough leaves of this woody growth serve the carpenter for polishing purposes, like shave grass. The bark is peeled off in the woods during the summer months and carried in bundles to the paper makers. Only the young, bush-like plants are used for this purpose. The skin of this bark is dark-brown, the fibres rough. It is found and worked up only in the southern parts of the country, *e.g.*, in the provinces Bungo and Iyo, and mixed with Broussonetia fibres for cheap papers. I met collectors of Muku bark only twice in my travels. On the boundary of Hiuga and Bungo it is called Mukubi.

Those kinds of bark which, besides those already named, are said to be employed here and there in paper-making (I myself, have nowhere seen them used), have been already mentioned above. It is said that in Chikuzen young bamboo-cane is chopped up and mixed with the pulp of Kôdzo. Straw admixtures, chopped fine, yield only inferior wares, as purely straw paper is far less valuable than bark paper.

Hô-gu, or Hô-gu-gami, *i.e.* used paper, and its repeated working up into inferior, but nevertheless strong paper, called Suki-gaë-shi, deserves mention. Just as with us, poor people in Japan and China also, seek through the streets and rubbish heaps for bones, old iron, and rags, and even old paper. Paper printed or written on, or soiled in any way and thrown aside, is collected, cleansed as far as possible, sorted and transformed anew into paper pulp. The Suki-gaë-shi thus made is used for packing paper, cleansing purposes, and pasteboard. Its value in proportion to the original bark paper is about the same as that of a dress made from old rags or worn garments ripped up and turned is to a new one.

About fifteen years ago, the Japanese began to collect cotton and linen rags and to manufacture machine paper after European methods. The necessary machines have been imported from Europe, also the directors of the factories, of which there are already a dozen. Such a one was first established in the vicinity of Kiôto, and another at Ôji near Tôkio. Attempts to put paper made in these mills on the European market were thwarted by the prices. A further discussion of these is not to our purpose here, as the factories were established generally by government help,

[1] The Vienna Exhibition of 1873, contained paper samples of Zahony from Podgora near Görz, which showed that in Europe also, in the districts of silk culture, where the bark of the white mulberry is very cheap and easy to obtain, they have tried it in paper industry.

and have not attained the rank of a domesticated national industry.

The plants which furnish mucilaginous material for bark paper-making instead of animal glue, are as follows :—

1. *Hibiscus Manihot*, L. The Japanese names of this weed-like species of Malvaceæ, which relate sometimes to the whole plant, and at others to the mucilaginous roots, are Tororo, Neri, Nubeshi, Tamo-Ôsho-ki, Nori-kusa (paste weed), Nebari (glue material), Aki-no-gi, Tsunagi (cement material). Tororo is a summer growth that, on account of its deeply-divided five-lobed leaves, and large light yellow blossoms, was brought from China to England early in the 18th century, as an ornamental plant. This variety is found here and there in Japanese gardens. It differs in its narrow, linear, lanceolate leaf-lobes from another whose indentations are much less deep, and which has broader lobes with notched edges. Only this variety is cultivated for paper manufacture. It is planted in rows like dwarf beans, whose height is also about the same. The sowing takes place in May, the flowering occurs in late summer, and the harvest of the thin, cylindrical roots in October. After cleansing they are dried in the sun, and hung up in bundles in a dry place till used. They do not form an article of trade, as each paper-maker cultivates the plant himself to the extent of his own want, which he estimates for the winter, as in summer the following species takes its place.

2. *Hydrangea paniculata*, S. and Z. This is a large bush growing all over Japan, found in mountain forests up to an elevation of 1,500 m. above the sea. It is called Shiro-utsugi and Nori-no-ki, *i.e.* paste tree, but in Tosa its name is Tadzu and Kami-no-ki (paper tree). In the last-named province of the island of Shikoku, the bush is sought during the summer in the mountain forests, the outer skin is shaved off and the bark is then peeled in finger-length pieces, and brought fresh to the neighbouring town. Here it is placed in a shallow vat, water is poured on and it is trodden with the feet to a coarse, pulpy mass. It is then put into pails or tubs, covered with palm leaves or grass, and taken without delay to the paper-makers, who soon make use of it ; for the mucilaginous bark of the Shiro-utsugi can only be used when fresh as a cement of the paper fibres and a substitute for Hibiscus roots.

3. *Katsura japonica*, L., the Sane Katsura or Binan-Katsura of the Japanese (see p. 262), is also said by several Japanese authors to furnish a mucilaginous bark to the paper industry. I do not know its use by personal observation, and as I am acquainted with many of the principal places of paper manufacture, I conclude that the employment of it can be but limited.

4. *Nori*, paste, like the mineral substitutes, is only used in the thicker kinds of paper to make them closer and whiter. Such papers are called Nori-gami, while those free from starch bear the name of Ki-gami.

MANUFACTURE OF BARK PAPER.

Although the materials which are used in the paper industry of Japan, and the varieties of paper made from them, are so different, the process is and has been essentially always the same, and the product hand-made or tub paper throughout. I have already observed that in modern times the manufacture of machine paper has been introduced also; this finds its use in newspaper printing, and has the advantage of being capable of receiving impression on both sides.

Before this, however, the manufacture of paper rested entirely on manual labour. Any shortening or lightening of the process by water power or machinery was unknown, so that one could speak neither of paper mills nor paper factories.[1] Paper-making was and is still (with the exception of a few modern factories mentioned above), a domestic industry in the true sense of the word, usually consisting of but one or two scoop vats in a house; but found in hundreds of places. Paper-making is often performed by simple peasants, who let it rest for months when, in summer, the work in the fields claims all their labour.

Before the fibre, which has been freed from the epidermis and green parts of the bark, is further treated, the edges of knot-holes and other defective places are cut out. It is then either laid for several days in running water, or at once, as is usually the case, boiled in an iron kettle with lye from a half-hour to three hours, till it is quite soft and can be crushed with the fingers. The lye is generally made from ashes, but sometimes from slaked lime. In Itchikawa (province of Kôshiu) was used, in 1874, a lye on Matsu-mata bast, prepared in a pail or tub by pouring hot water on a mixture of 2 Tô 4 Shô of wood ashes (Maki-hai) and 6 Shô of buckwheat straw ashes (Soba-hai). The soft, boiled bast pulp was washed in a tub with fresh water till, after four or five renewals, the water was perfectly clear. The process of preparing Broussonetia bast in Makidani-mura (province of Mino) was similar, except that here flowing water was used for washing. In Tosa and Iyo also, and at Nibu in the province of Yamato, where the interesting Yoshino-gami is prepared, and in many other places, I noticed the same operations.

With Gampi bast, 10 per cent. of burned lime (Ishi-bai) is added to the water, and I have seen lime used in Suruga in preparing Mitsu-mata also. The reddish brown colour which the bast acquires in this lime bath disappears after washing and a longer submersion in running water.

The bast material thus prepared in one way or the other, may be

[1] When the paper industry was established with us in Germany, in the 13th century, there were no stamp mills, which were introduced later from Italy. The raw material (rags) was boiled, beaten, and stamped as in Japan, till it had become a jelly-like pulp ready for the vats.

compared to our so-called half stuff. The further processes are easy and simple. The wet bast, laid on broad thick boards of hard wood, or sometimes on smooth, granite slabs, is transformed into an even, pulpy, fibrous mass by beating with cylindrical rods, or hammers of Kashi wood (*Quercus glauca* and *Q. acuta*), and frequent stirring and mixing with water. This work is usually performed by women. The short-handled hammers of from one to two pounds weight have often little channels on the beating surface which run together at the middle like the radii of a circle. In many cases the paper pulp, after the first process, is again boiled in a boiler with water only; but this depends on whether the separation of the fibres is complete or not.

When the material is ready it is handed over to the papermaker, whose work differs but little from the process of our hand-made paper. He mixes the fresh, wet balls of pulp in a vat, a flat, quadrangular box called Fune or Ô-haku, with the necessary amount of water and the mucilage of Hibiscus Manihot. The roots of this plant are beaten to pieces and smashed and placed in a bag which drips either into the vat itself, or is hung in a pail of water standing near and pressed out from time to time, as needed, into the contents of the vat. Barks which may be substituted for this Tororo, like that of Shiro-utsugi, must be boiled beforehand, Starch, dye, and mineral admixtures such as clay and chalk, when they are used, are all put into the vat with the pulp. The size of the vat corresponds to that formerly used universally in our paper mills, but is somewhat changed by the size of the form of the sheet, which is decided by the scoop net or the form, called in Japanese Suno-ko. This is a sieve of hair, thread, or bamboo, framed with four wooden bars, rectangular in shape. Usually the scoop net consists of fine parallel bamboo splints bound together with hemp thread, or it may be a sieve-like silk net painted over with Shibu (see p. 183) several times. Fine-meshed brass-wire net is not used, and iron must be avoided because of rust spots. In Japanese paper there are no water-marks, but here and there bamboo-cane forms, woven across the entire length and breadth in net fashion with hemp or silk thread, are used to produce figures in the paper. Such paper is called Mon-shi—Mon, meaning figure, design, and Shi, paper.

The dipping out of the thin film into which the pulp is spread out is done in this way: the movement of the form, letting the material flow to the side turned towards the papermaker, brings about the parallel deposition of the fibres described above. If the net is filled a second time, and now raised and lowered from left to right, the result will be a thicker and much stronger paper, as the new layer of fibres will cross the first at right angles. If the four corners of the scoop frame are movable, so that by a proper pressure on two opposite corners the several forms of a rhomb may be made from its quadrangular figure, and if this movability be used in the scooping of the sheet in the proper way, a ribbed paper is produced like the Tai-heishi or Gan-seki, which serves for the movable partitions between different rooms.

The wet sheets are piled up in layers on a mat—alternately with old forms or mere bamboo splints. When dry enough they are spread out on broad, smooth-planed boards with a soft, wide brush, and these are placed slantwise in the sun against the houses. As soon as entirely dry the sheets separate of themselves from the board and show one smooth and one rough side, Omote and Ura.

The finished paper is brought to market either in its natural condition, or cut and patterned. It is sold in Jô (books, quires), and there are usually 50 or 48 sheets in a Jô, according to the kind. There are varieties, however, which have only 40 sheets to the Jô, and in large sizes and thick paper often only 20 sheets.[1] One thousand sheets, or 20 Jô of 50 sheets each, make a Soku or ream, also called Kami is-soku.

Prominent Varieties of Japanese Bark Paper.

All the varieties are characterized by a yellow colour of several shades. They are classed by their other properties in two groups, as has been already said, viz. Ki-gami and Nori-gami. In the first, the root mucilage of Hibiscus Manihot is used as a glue, or the bast mucilage of Hydrangea paniculata; and in the other a paste of rich starch, to which, in some cases, fine chalk, clay or alum is added. The starch papers are closer, smoother, and heavier than the pure bark papers. In tearing them a fine white dust may be seen. Generally each bark variety is made by itself, the best known mixtures being made of Broussonetia and Edgeworthia bark.

The paper which is made from Kôdzo (*Broussonetia papyrifera*)[2] is by far the most general, as well the strongest, and has also the greatest number of uses. Kôdzo papers as a rule are lustreless, do not crush under the hand, are the firmest and most porous, and are made in the softest and most flexible varieties. The paper of the white mulberry bark stands next to Broussonetia paper, but is much inferior in evenness, fineness, and strength.

Gampi (*Wickstroemia*) paper is made only in light, thin sheets. It is known by its yellow colour, high silk-like lustre, and its great uniformity. It crushes also under the hand. One hundred sheets

[1] Strange to say, the Japanese language has no word for "Bogen," or sheet. It is reached only by circumlocution, *e.g.*, kami ichi mai, ni mai, etc., *i.e.* paper once, twice, etc.

[2] The fine, evenly twisted cord, known universally in Japan by the name of Midzu-hiki, and used for binding around presents, is made out of Kôdzo-paper. One side of it is coloured red after twisting.

of paper made from the Gampi represented in Plate XIII., each one 24 cm. long by 16·5 cm. broad, making 3·96 square meters, weigh only 45 grammes. Its firmness, however, is very surprising when its lightness and transparency are considered. It can be crushed, folded, rolled in balls, and then straightened out again without breaking or suffering in any way.[1]

Mitzu-mata (*Edgeworthia*) paper has also a distinctly marked yellow colour, but does not equal Gampi either in lustre, fineness, or in strength. Still Gampi and Mitsu-mata paper have much similarity, as is well shown in the microscopic examination of the bark cells which they contain. Then it is seen that the greater fineness and the silken lustre of these papers is produced by the difference of their cells from those of other varieties. They are scarcely half so broad as the Broussonetia cells, are much more uniform, the walls are thinner, and therefore have a higher lustre. It is possible on this account to recognise at once under the microscope, papers that are made from a mixture of Broussonetia bark pulp with that of Mitsu-mata or Gampi. The bark varieties of the other Thymelæaceæ, *e.g.* the Daphne and Edgeworthia, which are used in Himalayan countries for making paper, are related like the last two. The greater fineness of their cells and the less durable quality of their paper corresponds to that made from the inner bark of the paper mulberry and its kindred varieties.

About 40 per cent. of all Japanese hand-made paper is said to be manufactured in the two south-western provinces, Tosa and Iyo, in the island of Shikoku, and almost exclusively from the bast of Kôdzu bark. A considerable quantity of the latter, either raw or prepared, is sent to other parts of the country, notably Ôsaka.

The paper production of the province of Tosa for the year 1874 was given me as follows:—

1. Ô-ban-shi	532,000	Soku of 1,000 sheets.
2. Ko-ban-shi	2,989,000	„ „ „ „
3. Sugi-hara	2,900,000	„ „ „ „
4. Han-kire	36,000	„ „ „ „
5. Kasu-gami	581,000	„ „ „ „
In all	7,026,000	Soku.

In Middle Hondo, especially in the provinces Suruga, Kôshiu, Idzu, and Musashi, besides Kôdzu bark, a good deal of Midzu-mata is used, partly alone, and partly mixed with the former. In Mino, besides the celebrated Mino-gami of Broussonetia bast, a fair amount of Gampi-shi, or Gampi-paper, is made, although the

[1] In the elegant work of L. Gonse: "L'Art japonais," each of the coloured plates is covered with a sheet of Gampi, having all the advantages of silk paper, but distinguished far above the latter by its great firmness.

manufacture of the latter is by no means limited to this province, as Idzu, Ise, Aki, Echigo, and other parts of the country furnish it also.

SURVEY

of the names, origin, size, weight, and price of the best known and most important Japanese papers.

K. = Ki-gami. N. = Nori-gami.[1]

Name of Paper.	Origin.	Province.	Size of Sheets in Centimeters.	One Quire, or Jô. No. of Sheets.	Weight in grammes	Cost in sen.
a. Broussonetia papers, Kôdzu-seï, *i.e.* from Kôdzu fibre.						
1. Yoshino-gami K.	Nibu	Yamato	48×25·5	50	35	5
2. Mogami-gami K.	Taka matsu	Uzen	31×27·5	50	25	3
3. Tengu-jô, pure K.	Hirose ?	Mino	39×27	48	56	12
4. „ figured K.	„ ?	„	39×27	48	—	14·4
5. Mino-gami K.	Makidani mura	„	40×28	50	137	14
6. Mon-shi K.	„ „ „	„	40·5×28	50	125	18
7. Han-shi K.	Ino	Tosa	32×24·5	40	67	8
8. Ko-ban-shi K.	Chichibu	Musashi	26×20	50	87	7·2
9. Han-kire K.	Ichikawa	Kôshiu	52×39	50	200	8
10. Nishi-no-uchi K.	„	„	47·5×35·5	50	254	20
11. Shi-fu-gami K.	——	Iwaki	53·5×41	50	256	25
12. Atsu-gami, okiban K.	Ichikawa	Kôshiu	44×33·5	20	240	20
13. Atsu-gami, koban K.	„	„	42×29·5	20	200	15
14. Senka K.	Ôyachi	Echigo	56×39	20	250	18
15. „ „	Umadzu	Iyo	44×32	20	220	16
16. Ko-sugi N.	Ino	Tosa	25×19·4	48	72	5
17. Iyo-masa N.	?	Iyo	52×39	48	372	21
18. Hôshô N.	Goka-mura	Echizen	57×44	48	852	100
19. Jidzuki Ôtaka-gami	Tôkio	Musashi	60×42	20	600	34
20. Ôtaka-gami or Jûmon-ji	Kurashiyama	Iwaki	66×46	20	800	50
b. Edgeworthia papers, Mitsu-mata-seï, *i.e.* from Mitsu-mata only.						
21. Suruga-ban-shi K.	Kurasawa	Suruga	62×48	50	250	8
22. Han-kire, K.	Ichikawa	Kôshiu	55×16	50	84	4·5
23. Nori-ire N.	„	„	43·5×32	50	237·5	18

[1] The size and weight given in these tables I verified myself from a large number of the varieties in question. They relate to the best qualities unless otherwise specified. The weight of the Mon-Tengu-jô, or figured Tengu-jô, is not given because it varies too much owing to the manner of pressing with slaked lime. The prices are such as I found among the paper makers of Nibu, Makidani-mura, Ino, Ichikawa, Umadzu, and Kurasawa, or among the dealers in Tôkio.

Name of Paper.	Origin.	Province.	Size of Sheets in Centimeters.	One Quire, or Jô. No. of Sheets.	Weight in grammes	Cost in yen.
c. Mixture of Kôdzu and Mitsu-mata bast pulp.						
24. Han-shi K. . . . 7 parts Kôdzu 3 „ Mitsu-mata	Ichikawa . .	Kôshiu .	34×24	50	75	8
25. Shôji-gami K. . . 8 parts Kôdzu 2 „ Mitsu-mata	„ . .	„ .	40·5×27·7	50	135	10
26. Take-naga-gami K. 7 parts Kôdzu 3 „ Mitzu-mata	„ . .	„ .	67×26	50	325	30
27. Hôshô N. . . . . 8 parts Kôdzu 2 „ Mitsu-mata	„ . .	„ .	47×34·5	50	375	40
d. Wickstroemia papers, Gampi-seï, *i.e.* only from Gampi-fibre.						
28. Gampi-shi I. quality .	Makidani-mura	Mino .	38×28	48	52	9
29. Usego, uncut Gampi	„	„ .	50×36	48	96	18
e. Kuwa-kami, paper from the bast of *Morus alba*, L.						
30. Kuwa-kami I. quality .	Ichikawa . .	Kôshiu .	48×34·5	20	135	15
31. Kuwa-kami II. quality .	„ . .	„ .	41×27·5	50	164	15
f. Suki-gaë-shi paper, made from old used paper, or Hô-gu.						
32. Chiri-gami, grey paper	Tôkio . . .	Musashi	40×26·5	50	150	3
33. Suka-gaë-shi, best quality, grey-white	„ . . .	„	31·5×26·5	50	75	5

The most notable kinds of Japanese paper are given in the foregoing table. The detailed description is as follows :—

1. *Yoshino-gami*, named after the town Yoshino, in Yamato (see vol. i. p. 471), is not made there, however, but in Nibu, 4 ri distant. This last is the collective name of six little villages in a tributary valley of the Yoshino-gawa. In Nibu and vicinity this fine paper, celebrated throughout all Japan, and so much used in the lacquer industry, is called Urushi-koshi, *i.e.* lacquer filter, lacquer press. The Broussonetia, whose bark fibre is most carefully worked up, is much cultivated in the neighbourhood. The expressed bast-mucilage of Hydrangea paniculata, here called Tororo (glue), and Nori-no-ki (paste tree), serves as the cement. The mould is a net made of finely wrought bamboo sticks (taken from the sections between two knots of bamboo cane), bound with silk thread. The size and weight of the paper are given in the table. It is so fine that 50 sheets (1 Jô), or 6·12 square meters, weigh only 35 grammes, but

so firm that the two or three layers used to filter thick lacquer are not only not injured by the wringing and pressing through of the lacquer, but are afterwards smoothed out, dried, and used several times over for the same purpose.

2. *Mo-gami* paper is similar, but not so fine. It is made at Takamatsu, in the district of Mogami (Mogami-gori), province of Uzen, and is used, like Yoshino-gami, in the Northern lacquer manufacturing cities.

3. *Tengu-jô*, a name[1] which may be translated "prize-crowned labour," designates a class of papers which resemble the foregoing mostly. They excel in fineness and pliancy the thinnest silk papers, and are also much stronger. They are manufactured principally in Mino, are yellowish white, and are sometimes tinted with some colour. They are oftener printed with Gofun or chalk powder in various figures. These so-called Mon-tengu-jô papers are extremely well adapted for pasting on common window panes to make them opaque.

4. *Mino-gami.* By this term is understood pure Broussonetia paper, which is made in the province of Mino, and is noted for its great firmness. It is preferred on this account for covering wooden wares in the process of lacquering (see Kami-kise, p. 358), and for cord. Besides, it so transparent that it is also much used as a covering of the lattice of sliding doors, or Sho-ji.

The towns Hirose and Sakamoto, east of the Ibuki-gama, were named to me as furnishing good Mino-gami; but Makidani-mura is without doubt the most important paper district of the province. This embraces a tributary valley of the Gujo-gawa, whose mouth is 6½ ri from Gifu, the capital, at the town of Nagase. In passing through the eight villages which make up Makidana-muria, one sees the tokens of paper industry in the sheets spread out and drying on the Sugi planks before the houses. I was told by the burgomaster of Mitarai, the chief place, that this industry had been carried on here for more than five hundred years. Besides Mino-gami and Mon-shi, with its regularly separated transparent lines and figures resembling water-lines, Campi-shi is also manufactured in considerable quantities. The glue used is the root-mucilage of Hibiscus Manihot.

Han-shi, i.e. half paper, in combinations called also Ban-shi, is the commonest Japanese paper, used for writing, printing, handkerchiefs, and other purposes, and is made in several parts of the country. Like the two following varieties, it is inferior to Mino-gami in quality and price. Sugi-hara should be mentioned here—also a common variety, manufactured in many places, and which, like many other kinds, is carried, instead of handkerchiefs, in the wide sleeve of the Kimono or overcoat. The name Ko-ban-shi, *i.e.* small Han-shi, is given to a similar and still smaller paper used for the same purposes.

[1] From Tengu = proud; jô = distinguished, best.

Han-kire, i.e. "half cut" is also a paper much resembling Han-shi. The large scooped sheet is usually cut to half its length. It is on this paper that the Japanese keep their accounts and write their letters.

Nishi-no-uchi is the name of one of the best kinds of Ki-gami, made from Broussonetia bark. It was first made in large sheets in Nasu-gori, in the province of Shimotsuke, and later was imitated in many other towns. One of these imitations is called Magaï-Nishi (no-uchi), *i.e.* false, imitated Nishi. Forty sheets of the best quality from Shimotsuke cost 28 sen in Tôkio.

An excellent, strong, pure Broussonetia paper is the *Shi-fu-gami*, also furnished in many of the towns of the province of Iwaki, and is used for the peculiar Shi-fu fabric (which see).

A strong Kôdzo paper, made at Ichikawa, is called *Atsu-gami*, *i.e.* "thick paper." The paper industry of this town, situated in the province of Kôshiu, on the Fuji-kawa, is very remarkable, furnishing a great number of beautiful sorts, as noted in the catalogue.

Senka is the name of a yet stouter paper, which is used in making leather-paper and oil-paper. Of the starched papers (Nori-gami), the commonest and cheapest sort is perhaps *Ko-sugi*. It is made not only at Ino in Tosa, but also in the prison of Kôchi, the capital city, and elsewhere. It is used for cleansing purposes.

Iyo-masa is a soft paper, of which there are several varieties. It is well adapted for wrapping dried plants.

One of the most valuable and expensive Japanese papers is called *Hôshô*. It is thick, very strong, of even texture and gloss, rich in starch, and often contains alum. It is used as the legal paper for all important government acts, as wrapping paper for presents, and in other ways. Paper-money was formerly made of it. The celebrated manufacturing district for Hôshô is called Goka-mura, "the five villages," and lies in the province of Echizen, seven ri south-east of the capital, Fukui. The industry is prosecuted here mostly in winter. Genuine Hôshô is made from Kôdzô, and largely imitated elsewhere. A beautiful and interesting imitation is the Hôshô of Ichikawa (No. 27 of the table), which contains 20 per cent. of Mitzu-mata bast. It is made smaller and costs much less.

The *Jû-mon-ji* or *Ôtaka-gami*, and the *Jidzuki Ôtaka-gami* are large sheets of very thick, stout paper, used principally in the preparation of leather-paper.

After these come Nos. 21, 22, and 23 of the table, which are made from Mitsu-mata bast. The best known kind is the *Suruga-ban-shi*, a thin, slight writing paper. This is made in great sheets, not only in the province of Suruga, but also in other parts. It is employed for various cleansing purposes, and for writing and printing.

Of the mixture of Kôdzô pulp and Mitzu-mata pulp which are made at Ichikawa, the former always predominating, *Shoji-gami* is most notable, after the beautiful Hôshô. It, too, contains 20 per cent. of Edgeworthia pulp, but is free from starch, and serves principally, as its name indicates, to cover the lattices of Shoji, or sliding-doors, thus taking the place of window-panes.

Usugo is a thin *Gampi-shi* or Gampi-paper which appears in commerce in large sheets. Like the smaller Gampi-paper, it is manufactured from Wickstroemia bark without Nori, and is excellently suited for pricking patterns, for writing, and for making statistical tables. It is much used as copying-paper in foreign business houses in Japan, and will probably find further use in Europe also, on account of its pliancy, smoothness, strength, fineness and lightness.

The finer pliant Japanese papers, such as Yoshino-gami, Tengujô, and Gampi, and Senka (which is made soft and delicate as the finest chamois-skin by means of the crimping process), are excellent substitutes for old linen and lint in bandages. Chinese bast-paper, not so fine and soft, has long been used for surgical purposes in the hospitals of Hongkong and Shanghai.

In recent times it has often been successfuly attempted to use the stronger, smooth Nori papers, such as Hôshô, in colour printing and map making. Taking up the colours, as they do, without being first moistened, the lines of the drawing are perfectly retained in printing, whereas in printing with colours on our papers the moistening produces an irregular expansion or distortion.

Pasteboard or *Ita-me-gami, i.e.* "Board paper," is made in Japan, by fastening together, with Shôfu-nori, or wheat-starch paste, sheets of common paper, the process being therefore similar to that employed in Europe for the so-called glued pasteboard. Thus very beautiful, stout Ita-me-gami is obtained if 10 to 20 sheets of *Hosokawa*, a Broussonetia-bast paper from Iyo, are pasted together. A great deal of pasteboard is made directly, by this process, from the better sort of Suki-gaë, or waste paper, and even from old business documents, and other paper already used (Hô-gu). When covered with a coating of nice, fresh paper, the Ita-me-gami looks handsome enough.

Hari-nuki is Japanese papier-maché.[1] The preparation of papier-maché, however, differs from the last mentioned process, in that the paper is pressed in forms after being softened in water and reduced to a pulp (pâte), while Hari-nuki is made like pasteboard. All Hari-nuki products consist, therefore, of so-called "couched boards." The couching is done over wooden forms. The light Hôn-gu, already written on or printed, is used, in case the objects are to be lacquered afterward; or better, unused paper, under other circumstances. Sheet after sheet is stuck on with wheat-starch paste, and smoothed out over the wet Kata, or form,

[1] The word is derived from Hari, -ru = to stretch out, to spread; and Nuki, -ku = to draw out.

until the required thickness is obtained. Then the articles are dried, cut, and lacquered.

In this way hundreds of small, light, and yet durable articles are made, which find ready acceptance. Thus, not only dolls' heads and other toys, but also pretty little plates and saucers, tea-caddies, and pipe-cases are produced; and they look as if made of lacquered tin-plate or wood. They answer all purposes of strength and durability, are surprisingly light, and cheap in price, being similar in this respect to papier maché, but far exceeding it in firmness and elegance.

Paper hangings or *Kara-kami*, *i.e.* China paper, also are made and used in Japan, not in long rolls, but in sheet size, and not to a large extent. Many of the printed patterns are not less beautiful than our finer papers, and are far superior to them in durability. As the name indicates, this industry also originated in China, where paper was first used for hangings.

Manufacture of Chirimen-gami, or Crape Paper.

By a very simple mechanical process, the smooth surface of several bark papers, and of picture sheets made by the colour press, are twilled, and stiff cardboard paper is made soft and pliant as chamois skin, and given also an elasticity which surprises us, especially in certain kinds of leather-paper. The tools which are used in the manufacture of Chirimen-gami, are the Momi-dai,[1] a kind of lever press, and the Katas, or moulds, large brown sheets of thick paper which are grooved in parallel furrows, either all to one side, or in several directions, and on being moistened show considerable elasticity.

The press (Momi-dai, Fig. 14) is usually made of Kashi, the wood of an evergreen oak, or some other hard wood. It stands on a foundation consisting of a large, heavy board, through which two perforated posts are fastened as tenon-bearers, between which lies the fulcrum of a lever *a d*. *b c* is a wooden cylinder of 2 to 3 centimeters diameter, and length varying according to need, *i.e.* whether the sheet rolled around it is large or small. This also determines the height to which the tenon for the fulcrum of the lever is raised. The cylinder *b c* rests at *c* in a pan-like hollow of the board, in order to prevent change of position, and goes through an elliptical hole in the arm of the lever. As *a d* the long arm of the power (2½ to 3 meters long) is considerably longer than that portion from the cylinder to the end of the lever *d*, a great pressure on the paper sheets rolled around the cylinder can be applied. The sheets are moistened by sprinkling with a wet brush, or by piling them up in alternate layers with wet paste-boards, and subjecting them in this way for an hour, to a mild

[1] Momu = to rub, to make soft; dai = table.

pressure. Then a large brown Kata sheet is spread out on a wooden slab, and a sheet of the moistened paper is laid over it, and then another Kata, and another sheet of the wet paper till they lie ten and more, closing with a sheet of Kata. In this arrangement of layers, the single sheets must lie even with the separating sheets, and thus have their edges parallel, or inclined to those of the larger Katas. When the pile is made up in this way, it is laid on the cylinder *b c*, and the whole is

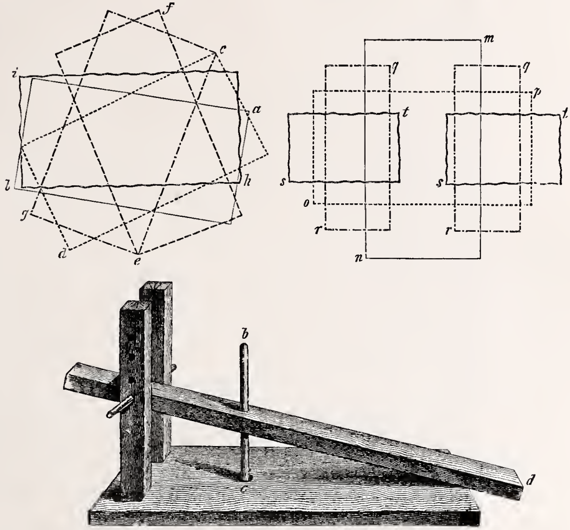


Fig. 14.—APPARATUS FOR THE PREPARATION OF CRAPE PAPER.

rolled tightly around it, making it some 10 to 12 centimeters in diameter. The cylinder is then diagonally and fixedly wound around with a strip of hemp canvas, about 30 cm. wide, and 2 or 3 meters long. In doing this the workman generally uses his feet. He then places the cylinder on the press, fixing one end on *c*, and putting the other through the hole of the lever. He presses the lever at *d* with all his might, by jerks, from six to ten times down on the roll, which is by this means considerably compressed in the direction of its axis. It is now taken out of the press, the workman removes the canvas band and the cylinder, unrolls it, takes the strongly pressed Kata sheets again apart, and builds another pile from them and the paper sheets, only with the difference that this time they must be laid in another position relative to each other. Then follows another rolling and binding in the damp canvas and pressing as in the first instance. After this has been done eight or ten times, each time with a different position of the sheets from that of the Katas, the work is complete. The sheets have become considerably smaller in both directions. Then they are stretched a little, and can now be put to further use. The transformation into this twilled, soft elastic condition is a gradual one. The sheets having first the position *a b* (in Figure 14), appear after coming from the press ringed in a net-like fashion, and all strongly in one direction. After the second pressing in the position *c d*, these rings are crossed and diminished by those in the second direction. After they are packed with the Katas the third time in the position *e f* and subjected to the pressure of the Momi-dai, they have instead of the length and crosswise rings, a distinct huckaback texture. With each new operation, as they are successively placed in the positions *g r*, *h i*, *m n*, *o p*, *q r*, and *s t*, this marking becomes constantly finer and more regular, and the shrinking of the sheets and increasing softness and pliancy go hand in hand with this transformation.

The process of making figured sheets with coloured prints, soft and twilled, is similar to the foregoing, save that in this two such sheets with their printed sides turned toward each other are enclosed between two Katas, and separated by a sheet of Han-shi lying between. After the seventh arrangement and pressing of the piles, the Han-shi sheets are removed, the two contracted picture-sheets are laid together and pressed twice more.

The mechanism and processes already mentioned have been described and illustrated by Herr von Brandt (who so kindly aided me in my studies in Japan) in the Fifth Book of the German East Asiatic Society, just as we observed them together in several workshops. Figure 14 is borrowed from his sketch given there. As we were told in answer to our inquiries concerning the manufacture of the Katas that it was a trade secret, Herr von Brandt, at my suggestion, bought several used and worn-out sheets, and divided them between myself and our deceased friend, Dr. H. Ritter, for further investigation. Two days later each of us, in spite of the fact that we had followed wholly different paths, could report to the surprise of Herr von Brandt, as a result of our chemical and microscopic examinations, that these brown Katas were made up of pieces of old used-up Broussonetia-bast paper (in my case they consisted of old receipts), pasted on each other and together; that these had been strongly compressed and ringed in several directions with the wrapping sheets and the press, and finally had been saturated and coloured with Shibu (p. 183).

I then betook myself with this result and the old receipts

Japanese leather-paper.

obtained from the Katas and made legible, to one of the manufacturers of Chirimen-gami, whose place we had visited, and my interpreter displayed the results of our investigation. The answer, reduced to one sentence, was, that it was useless to hide anything any longer from the Sen-sei.[1] This had the desired effect. The man led us into a room and showed us his Oya-kata (matrix) or Ki-gata (wooden mould). It was a board 5 to 6 cm. thick, 90 cm. long, and 30 cm. broad, of hard Sakura wood (*Prunus pseudo-cerasus*), resting on two supports. This board was most carefully grooved lengthwise with regular furrows 2 millimeters deep and about the same distance apart.

In using it, a large sheet of cardboard is saturated with a paste solution, and then laid lengthwise on this form, and with a bone folder pressed into every furrow of the foundation, a work which demands a great deal of time and patience. When dry the form is firmly imprinted and the sheet is furrowed in parallel lines. It is painted with Shibu on both sides, and then serves for common Katas of the kind I have mentioned. The moistened sheets destined for this purpose are wrapped in these grooved sheets and put once or twice under the press, like sheets which are to be transformed into crape paper. The coating with Shibu which follows makes them firmer and more durable.

Leather Papers, or Kami-kawa.

These are brought to market in different colours, twilled and smooth, simple or sometimes printed and gorgeously ornamented in raised arabesques, flowers, and other decorations. A beautiful appearance, surprising elasticity, and a softness that reminds one of calf-leather, especially on the under side, are the prominent characteristics of this kind of paper. (See the sample, Plate XIV.) It combines with these considerable firmness which exceeds that of our oilcloth in many cases. Out of it are made letter portfolios, tobacco bags, pipe cases, boxes, small chests, and other articles. It is also used as a floor-covering, like oilcloth, and instead of paper hangings. The simple twilled black-lacquered leather-paper serves also for the Saki-kake or Saki-kawa, with which the feet are protected from rain by drawing them over the Getas or wooden shoes.

Kami-kawa is manufactured generally in sheets, but also in large pieces. Such a one, 36 feet long and 3 feet wide, with red lilies and green leaves, cost in Tokio 5½ yen. It was eminently adapted for the hangings of a salon.

A great deal of leather-paper is made in Tôkio (in the quarters Honjô and Fukagawa, on the right of the Sumida-gawa). The

[1] The Sinico-Japanese word, "Sen-sei," is the honourable title of a learned man.

province of Ise also furnishes a considerable quantity, as I myself can testify of the towns Matsuzaka, Inagi, Omada, and Tamura in the vicinity of Yamada. The same may be said also of Harima and Mita. Ôtaka-, Jidzuki- or Jumonji-gamia, strong Broussonetia papers, are used in manufacturing it. In Tôkio the process is in essentials as follows :

1. The paper is spread out on a board so that the smooth side lies upward. It is coated by means of a broad hair brush with a thin rice-paste to which lampblack has been added, and then hung on horizontal poles to dry, which takes from one to two days.

2. It is generally twilled by the process given on page 408, during which the sheets shrink considerably in both directions.

3. Then follows a coating of Yegoma-no-abura on the same side, and a thorough drying in the sun, occupying from 5 to 20 days, according to the time of year.

4. Upon this follows a coat of paste-solution in which is mixed the dye which the leather-paper is to receive (red oxide of iron, orpiment, indigo, india-ink, or a mixture of such colours).

5. After the paper is dry again it is impregnated with lacquer, using Se-shime-urushi for light colours and Hana-urushi for black. Two workmen sit opposite each other, smear their hands with lacquer, and beat them quickly on the sheet spread out between them. Then drying takes place, the sheet being spread out on a frame covered with paper.

6. If the leather-paper is to be figured, carved wooden moulds are pressed in at the close of the crape-process, and the different colours are put on through paper stencil plates. A metallic reflecting surface is obtained after the figures are made by fixing bronze powder with lacquer, and polishing when dry.

There are leather-papers also which contain no lacquer, but are dried in the smoke of a fire of rice straw, and then rubbed. A quite peculiar leather-paper, resembling parchment, is the semi-transparent Yogan-gami, whose method of manufacture I was unable to learn. The Englishman Gaine some years ago described a process (the product was investigated by Prof. Hofmann) whereby he transformed paper into a kind of parchment by dipping it for a few seconds in sulphuric acid reduced one-half with water. But sulphuric acid can scarcely be concerned in the manufacture of Yogan-gami, as it was not known in Japan in former times.

Paper-fabric, or Shi-fu.[1]

The word Shi-fu in Japan is the name of a peculiar fabric which is now manufactured only in Shiroïshi, a small town on the Ôshiu-kaidô, 13 ri south of the city of Sendai. The warp consists of silk

[1] Shi = Kami, paper ; Fu = Ori-mono, fabric ; as in Bashô-fu, Manilla-hemp fabrics ; Kudzu-fu, fabrics made of Pueraria Thunbergiana.

and the woof of paper threads. The paper used in its manufacture, called Shi-fu-gami in Shiroïshi, is made of Broussonetia fibre in several places in the province of Iwaki. One Jô of it, or a quire consisting of 50 sheets, the size of our common writing paper, costs 25 sen, or one shilling.

Half a Jô of this paper is often folded lengthwise, and laid together so that the two parallel edges are over one another and project 3 or 4 centimeters over the edges. The paper is laid lengthwise over the one narrow side of a thick board provided with feet for firmness, and fastened at both ends with iron bent clamps, so that the two projecting edges of the paper form a right-angle with the principal part of the sheets, and hang down. Then the folded part of the paper parallel to the width of the sheet is cut with a broad, hatchet-like, very sharp knife into narrow strips of scarcely 2 millimeters' breadth, which hang together by the projecting edge which has not been touched by the knife. Now follows the rolling of these strips of connected paper ribbons on a smooth stone slab, with the flat of the hand, a work which is continued, with frequent twisting, till every ribbon has become a slack thread. The connecting edges are then cut on both sides so far through that the single threads hang together by a width of only two millimeters broad, and then the connecting places are twisted also. In this way continuous threads are obtained. The finished fabric made from such entwined paper threads for woof and silk warp, is called Fukusa-ji, *i.e.* "ground for Fukusa." Fukusa otherwise denotes the silk covers for fine presents, such as lacquer-ware and the like, but here quadrangular pieces which are printed with flowers or landscapes, and serve for covering presents.

In making Shi-fu fabric for clothing, the paper threads are twisted beforehand, right and left, similarly to those of the silk woof for Chirimen or crape-silk, and run in the fabric alternately once in and out, *i.e.* two right-twisted woof-threads follow two left-twisted threads, and so on. When the Shi-fu fabric is finished it is placed in boiling lye made of straw ashes, then washed, dried, and stretched. It acquires in this process a twilled appearance, and is considerably shrunken. It is now given to the dyer before being worked up, and is printed in various patterns.

This peculiar branch of industry which I have described was introduced in Shiroïshi 90 or 100 years ago, and was carried on by Samurai families. It is said to have been at its height 50 years ago, when the Shi-fu material, which can also be washed, was very popular for women's summer clothing. Later, when, in consequence of the commercial treaties, the incomparably finer and more durable English cotton fabrics were brought in such quantity and at such low prices into the country, this industry declined rapidly, so that twelve years ago it was carried on in six or eight houses only.

Oil-paper and Water-proof Cloaks.

(*Japanese: Abura-gami and Tôyu.*)

The oiling of certain Japanese papers is intended either to make them transparent, *e.g.*, for lanterns, or as a protection against water, as for umbrellas and the regular oil and leather-paper. The Yegomano-abura (see p. 155) is always used for this purpose, while the paper employed is a stout Broussonetia paper; in Niigata, *e.g.*, the Senka from Oyachi, in Tôkio a similar one from Tosa and Iyo. In the first-named place the sheets are pasted together by rolling and kneading before they are made soft, and in the latter after this is done. In Tôkio it has been the custom to make the paper pliant by means of the crape process (see Fig. 14). The gluing together of the sheets is done with a mixture of paste made from the flour of the common brake (p. 68) and Shibu (p. 183). After the sheets are glued together to form large pieces, made soft, and again smoothed out with the hands, they are painted with a broad brush on one side with a mixture of lampblack (Matsu-susu) and Shibu, and then laid in the sun to dry. This takes at least five days. Then follows a coating of Yegoma-no-abura (Perilla oil) mixed with Shibu, another drying, and a new coat of this cold mixture, the oil of which must have been previously boiled, and at last the final drying. The entire process takes at least 15 days in good weather. Lampblack, of course, is only used for black oiled paper and waterproof cloaks; for lighter varieties, gamboge or some other light colour is used.

These oil papers cannot compete in Europe with oil-cloth and india-rubber textures, as they are far inferior in appearance and durability. Their manufacture in Japan does not date back much before the opening of the country. In earlier times people wore common coarse cloaks or mats of rushes and grass, *e.g.*, Mino (page 172), as a protection from rain.

To protect the head from rain and sun the Japanese began very early not only to wear large hats made of willow and other materials, but also to make clumsy paper umbrellas and parasols, which were in general use. But the oiled Karakasa could not be used in the sun, nor the unoiled parasol (Hi-gasa) in the rain, therefore the quick acceptance of the European silk umbrella by the well-to-do classes is easy to understand, as these were not only lighter and handier, but had the preference, especially in that they could be used "en tous cas" in every sense of this expression. It was very much the same with hats. In fact, fifteen years ago the felt hat and silk or cotton umbrella were the foreign articles (now they are manufactured in the country in sufficient quantity and quality) which, next to the petroleum lamp, had pushed farthest into the interior of the country. Soon there will be no more umbrella makers who do not go to the silk mercer rather than the paper dealer for material to cover their frames.

In Eastern Asia, bast paper has till now been a substitute for glass in windows and in lanterns also. The paper lantern, Japanese Chôchin, plays its part still in Japan. No house is without it. The houses and verandahs are lighted with them at night, and with their help one picks his way afoot or in Jinrikishas on the street. They illuminate the water on the evening boat ride. Tea houses, theatres, and other pleasure resorts are distinguished by rows of variegated paper lanterns, and in the great temple feasts, occurring every year in honour of the popular gods, the Chôchin are a feature in the parades, which somewhat resemble those of the Carnival. Often a whole street, even an entire quarter, in the vicinity of the temple is adorned in this way with paper lanterns. Like the green fir-tree of the modern *via triumphalis*, here on both sides of the streets are rows of bamboo canes, hung with beautiful lanterns, and sometimes canopied with a large umbrella frame, whose long beams are trimmed with alternating white and red paper flowers.

The best known articles made of Japanese bast paper[1] which have found great popularity in Europe, and still more in America, are fans. They are called Ôgi, *i.e.* those that shut up, and Uchiwa, the simple round stiff fans. Both kinds have been made for centuries for the home market, chiefly in the three capitals or Fu (Kiôto, Ôsaka, and Tôkio), and likewise for foreign countries in later years. Other cities, such as Nagoya and Fushimi, also take more or less part in the manufacture. The export of fans has given a new impulse to the industry, and effected moreover a division of labour as in a factory, as was not formerly the case to such a degree. There are pattern designers whose sketches fashion the work, houses which furnish only the bamboo frames, and others in which the handles are lacquered and ornamented. Another group of persons undertakes the painting or printing of the paper, upon which the foreign customer often exercises an influence, though not always with good taste.

Frames and decorated sheets for covering both sides of the fan are then given into the hands of other workmen, who are again divided into several groups, and whose first work consists in folding the paper to correspond with the bamboo ribs. A sheet of paper is pasted on one side of the frame and the corresponding second painted sheet is bound on to the other side in the same way. When this is done, the fan must be opened and shut repeatedly, and fixed here and there in imperfect places so that the paper will lie easy in the folds and spread without difficulty, as occasion demands, and as only such a tough and pliant material as bast paper will permit. This is the manner of proceeding with the Ôgi or folding

[1] This is in many cases superseded by a light cotton or silk fabric.

fans, while the Uchiwa give far less work owing to their simpler form.

Of the former, the finest manufactured in former times for home demands cost scarcely 5 yen, while now they are made for foreign customers with mother of pearl and ivory decorations to cost three or four times that amount. The large majority of foreign customers care principally, however, for the cheapness of these wares, and the market is greatly influenced thereby. A hundred of the common sort of Uchiwa may be purchased in Ôsaka for from 1 to 2 yen, and singly, for from a halfpenny to a penny.

During the decade 1874–1884, the export in Hiogo in 1879 reached its highest, with a value of 163,730 yen, and two years later in Yokohama with 176,666 yen. The following table shows how it has wavered in both places since then, and later has fallen everywhere :—

	Hiogo.		Yokohama.	
	Pieces.	Value.	Pieces.	Value.
1881.	3,631,067	88,991 yen.	10,076,118	176,666 yen.
1882.	2,735,120	67,513 „	5,513,791	112,430 „
1883.	2,647,966	66,393 „	1,919,840	40,812 „

Appendix: Japanese Writing Materials.

What they consist of:—Brush, India Ink, and Ink Dish.

Among the manifold uses of East-Asiatic bast papers, the most important is after all the employment of it in the fixation and communication of thought. Next to the paper, and even more than pen and ink with us, the most necessary articles of a Chinese or Japanese *escritoire* are the brush and India ink. Besides these, there must be moreover an ink dish and water, for rubbing the India ink.

The Yatate, or portable writing-case, which the business man always carries with him, includes a holder for fluid India ink and a brush in a copper case. For household use, there is a handy shallow box called Sumi-ire, with several compartments—one for the brush, a second for the stick of India ink, and the third for the dish. On an upper tray of the outfit is a copper or silver vessel for water. In Industrial Art Collections one may often see specimens of Japanese writing apparatus in the shape of flat, square boxes, decorated most richly and beautifully with gold lacquer. These are among the most prominent productions of Japanese lacquer industry.

The Fude, or brush, used for writing, most nearly resembles Fig. 10 on Plate IV., though the hair of the rabbit or deer of which it is usually made generally forms a thicker, blunter end. After the hair has been rubbed with the ashes of rice straw, rich in silicic acid, and purified, it is brought into parallel layers with a fine brass comb and sorted according to length. It is then glued with Fu-nori or seaweed paste (see p. 82) to a piece of linen or cotton stuff, three or four centimeters wide, whose thickness is governed by the size of the brush. This is now rolled up into a cone, its lower end enclosed in a paper cover, and the handle end glued into a piece of bamboo cane of the length and thickness of a lead pencil. The brush is now ready for use.

The use of India ink, Jap. Sumi, dates back further than that of our writing ink; in Eastern Asia it is at least as old as the use of paper, if not older, for it is believed that it was invented in China about 260–220 B.C. The province of Kiang-si, and especially the city of Jaotscheu, south-east of the Lake Poyang, was celebrated for centuries for its excellent India ink. It had the valuable property of becoming harder and blacker with increasing age. The industry spread later over several other provinces, chiefly Nganhwui—where the city of Hwuichau has a high reputation for its ink—and the province of Kwang-tung. The English name "India ink" indicates the way by which this fine Chinese preparation first came into Europe.

Although Japan manufactures for itself the largest part of the Sumi used in the country, the Chinese product is even here regarded as better, and commands a higher price.

Lamp black and animal glue form the essential constituents of India ink. The glue only serves to unite the fine particles of carbon which are produced by imperfect combustion, and to fix the ink on the paper by the use of the brush. Musk, camphor, or some other aromatic materials, are used in small proportions with the ink, to hide the unpleasant odour of the glue, but are not essential.

Pine-soot (Susu) which was formerly used, was superseded by lampblack, Jap. Yu-yen, which can be obtained by burning any kind of fat or fatty oil. In Japan, however, and still more in China, it is made best and with preference from the Dokuye-no-abura, or oil of the *Elæococca cordata*, Bl. (*Dryandra cordata*, Thunb., see p. 155), 100 Catties of which (600 grammes) will yield 8 Catties of pure lampblack.

The lamps used for this purpose are small crucibles or dishes of stoneware, about 14 centimeters in diameter, with wicks of rush-pith. A cone-shaped soot catcher of burnt clay is placed over each lamp, and from hour to hour a new one is substituted, and the soot is carefully brushed off and swept together by the beard of a quill, and is then sifted through a fine hair-sieve. The glue (Japanese Ni-kawa) made from ox-hides and isinglass, must be very bright, and acts as a cement. To ten Catties of lampblack from the oil of *Dryandra cordata*, Thunb., four Catties of old ox-hide glue, and one half-Catty of old isinglass are reckoned. These ingredients, after the glue has been boiled in the necessary amount of water, are thoroughly mixed in a porcelain dish, a wearisome labour, as the lampblack does not readily unite with water. When this is finished, the mass, which now may be kneaded and formed like bread dough, is shaped into round balls, which are wrapped in linen, and placed in a stone-ware vase perforated at the bottom, and here subjected to steam for fifteen minutes. Then the material is taken out from its coverings and worked in a mortar with a pestle for at least four hours, till it is entirely homogeneous and plastic. It is now formed into large prismatic bars, which are placed for a moment in a jar having a temperature of about 50°, then stretched into longer sticks, more nearly the size of the India-ink sticks. These are then placed on a kind of anvil, and beaten with wooden hammers, and constantly turned till they have acquired not only the proper form, but also the desired lustre. They are once more kneaded on a smooth table, with an admixture of musk or some other fragrant substance, and then the sticks are formed by hand, and put into a wooden press. For drying of the sticks rice-straw ashes are used, which are first sifted and thoroughly dried in the sun. In the drying box a layer of ashes, three centimeters deep, is followed by a layer of India-ink sticks, then ashes again, and a second layer of ink sticks, and then ashes at the last. The length of the drying process depends on the amount of water they contain and accessory circumstances. When it is satisfactorily finished, the sticks are taken from the ashes, brushed off, laid in a small sieve, and placed for one or two days in a shady place, where the process is completed. They are then polished by rubbing with a brush, and printed with several Chinese characters. They should not be used for several years after making, as their hardness, dark colour, and lustre, in use, increase with age, though apart from this, the quality depends largely on the fineness and lightness of the lampblack, the purity of the glue, and carefulness in manufacture. The best pieces of Indian ink are recognised not only by the marks already mentioned, but by the sound, and by a tinge of brown colour.

The Sudzuri or India-ink dishes used by the Chinese and Japanese, are not the poorly adapted porcelain or stone-ware dishes which we use, but are always better suited to the purpose, made of a fine-grained dark stone, chiefly of old slate, serpentine, or coloured marble. In Japan an old, dark blue slate is especially prized for this, and generally used. It is called the Amabata-ishi, known throughout the country and named after a small town, Amabata, in the Province of Kiushiu, in whose neighbourhood it is chiefly found. Many of these Amabata stones are worked up where they are found, but some are brought to Kôfu, where I saw them prepared. The outline and hollows of the stone are wrought out with a chisel-like nail,. having a long wooden handle. A hollow is made on one side for holding the water, and for collecting the ink afterwards. Rubbing and polishing follow the chiselling, and then the stone is given a coating of India-ink and washed over with Rô, or vegetable tallow. When using India ink, a few drops of water are poured into the hollow before mentioned, the stick is just dipped in, and the water is brought by it to the upper part of the dish, the process being repeated again and again till the greatest part of the water is brought up. Then comes the rubbing off of the ink, which gradually runs back again into the hollowed place.

6. Wood, Ivory, and Bone Carving. Tortoise-shell, Horn, and Mother-of-Pearl Work. Polishing of Stones.

Many of the productions of Japanese art industry enumerated here, belong to the very wide classification of petty wares and jewelry, while others are works of genuine glyptic art. The skilful hands of the Japanese artist enable him to impart to even a hard, brittle substance, wonderful life and action. But even here this art is seen and practised, not so much in great monumental creations, as in little petty forms, which must be closely observed before their character and artistic worth can be really known and appreciated. Of such a character, more than all others, are the so-called Netsukes, generally carvings of wood, ivory, or bone, which seldom surpass 2 to 5 centimeters in height, and twice this size in circumference. The Netsuke are used as a sort of button, especially for hanging the tobacco pouch to the girdle. When used for this purpose they have holes bored through on the under side, through which a cord usually connecting them passes, with the hanging pocket. The Netsuke is pushed through between the clothing and the girdle which confines it at the waist, and shows above the girdle, the pocket hanging from it.

Men and animals, especially monkeys, rats, and mice, either singly or in groups, and in various positions, as well as other creatures, and flowers, are copied in the Netsukes. The comic element is largely represented. It is brought out in such condensed and expressive manner, that the artist's meaning is grasped at once, and its humorous effect is not lost. The artistic conception of these Netsukes is as much admired as the ease and life of the expression and position, the care and skill of execution which is able so happily to overcome technical difficulties. "Whoever wishes to study Japanese art, must not fail to devote particular attention to these Netsukes."[1]

It is no wonder, then, that Netsukes, especially those of ivory, are the most sought for and the dearest in price of all the petty wares of the Japanese curiosity dealers, and that those European collectors

[1] Carl Senft, in Official Report of the Vienna Exhibition. Group 10, Petty Wares.

who succeeded in securing a fine collection of them at a time when the demand was small, the choice large, and the price low, look upon the same with great pride.

Wood carving, or Ki-no-hori-mono, was first practised in Buddhist Asia, as in Christian Europe, for the adornment of temples, and has received thereby much inspiration and encouragement. From the beginning of the sixth century, when the first statue of an Indian saint came from Corea to Japan, till now, the making of Moku-butsu or wooden idols, has been the chief work of Japanese wood-carvers. The largest and most effective products of their art are undoubtedly the two gatekeepers usually stationed at the two sides of the tall outer doors (Sam-mon) of a Buddhist temple; tall, naked athletic figures, three or four meters high, with grim expression of face, and a muscular development that is represented often with wonderful power and truth. They are called Ni-ô (Niwo-sama) "the venerable kings." The two Ni-ô in the southern golden hall (Nan-yen-do) in the vicinity of the formerly celebrated temple Kô-fuku-ji at Nara,[1] are especially noteworthy. It is customary also to represent in wood various personages, prominent in Japanese history. Among the smaller sculptures of this sort, a statue of Hitomaro (Kaki-no-moto-no-Hito-maro), a celebrated poet who lived 1200 years ago, is very frequent and well executed.[2] It is a typical, noble, intelligent figure, always represented in a sitting posture. On the bent knee of the extended right foot rests the right hand holding the brush (Fude), on the left knee a small tablet which supports the left arm. He wears black lacquered wooden shoes (Kutsu) on his feet, and on his head, the black, stiff hat (Yeboshi). An imperial completes the characteristic appearance of this old Japanese figure.

The figure of Hitomaro, usually carved in Koku-tan or Shi-tan (ebony or sapan-wood, see pages 250 and 253), is always artistically and carefully treated. This appears mostly in the folds of the garments and in the noble features of the countenance; and the work differs in this from the more artisan-like making of many of the idols.

Nikko exhibits in wood carving as in many other branches of industrial Art, superior productions, among which the Nemuri-no-Neko, or "sleeping cat," over a door near to the tomb of Iyeyasu, is most prominent. Beautiful wood sculptures, which are not much its inferior in artistic value, are still to be found, some as reliefs on columns, doors and roofs, some in the open work above the inner walls of several temples and buildings belonging to them. Most of them represent the animals of the zodiac, or pæonies, and

[1] "Among a crowd of miscellaneous images are an excellent pair of Ni-ô, the anatomy of which is perfect. They are the best examples of sculpture in wood to be seen in Japan."—See Satow and Hawes, "A Handbook for Travellers in Japan." Second edition, p. 389. London, 1884.

[2] See "Handbook," etc., page 401.

other favourite flowers. The wood ornaments on the portal of the Higashi Hon-gwan-ji, the metropolis of the eastern branch of the Monto sect at Asakusa in Tôkio, are admirably beautiful and carefully executed, consisting of the leaves of flowers of the pæony and chrysanthemum. Besides these, the Japanese armorial animals are often carved in wood with great skill and artistic force. Europeans in modern times have done much to promote this branch of industry by ordering hunting, and other animal pieces, to hang in dining rooms.

Zôge-no-hori-mono, or Ivory Carving.[1]

The ivory work of Canton, *e.g.* the ornamental balls of open work one within the other, and many landscapes, stand unrivalled as evidences of surprising skill combined with astonishing patience and perseverance. But many Japanese works of this description, especially their Netsukes (Zôge-no-netsuke) show a much more developed artistic talent. Kiôto, which in former times was the chief seat of ivory carving, has been long surpassed by Tôkio, which furnishes besides Netsukes, jewel cabinets for ladies, chests and boxes, card cases, chessmen, buttons, brooches, and many other articles, partly for the domestic market but mostly for foreign countries. The articles are in general made with extraordinary care, and ornamented, not only by engraving and carving, but often by well designed lacquer-work besides. On the other hand, ivory, like mother of pearl, is inlaid in fine lacquered articles.

Connected closely with this work is that of Hone, or bone carving, for which the thigh bone only of the larger domestic animals is used. But owing to the limitations of the material, in view of its smaller size and more difficult working, and its much inferior appearance to that of ivory, it plays but a modest part in Japanese industry and is very little used for Netsukes. Those many small articles which with us are turned by the lathe out of bone, are either not used, or some other material is employed in making them. Agriculture and the branches of chemical industry have up to this time made even less use of bones.

Bekkô-zaiku, tortoise-shell work and its horn ornamentations, are executed mainly in Nagasaki and Ôsaka. The two substances here regarded are closely related in quality and in the purposes which they serve. Both are made soft by warm water and also by dry heat, and are then easily stretched and bent, pressed and formed, split apart and welded together, properties on which the art of working them up is founded.

Bekkô, tortoise-shell, comes principally from *Chelonia imbricata*, L., the genuine loggerhead turtle, which is found in all tropical seas, but especially in the Malay Archipelago and Indian Ocean. Singapore in Asia, and London in Europe, are the principal mar-

[1] Zoge = ivory; hori = to dig, to carve; mono = work.

kets for its thirteen yellow and brown glowing plates. From the former, Chinese junks carry the material to the dealers in China and Japan, but the best comes to the ports of Japan from London. When it has a light gold-yellow colour and is very transparent, it is used in Japan especially for Kanzashi, or fork-shaped hair-pins for young ladies, highly appreciated and dear in price, some of them 16 centimeters long. Besides these, girls of the wealthier classes wear a straight four-cornered little wand of the same material, and from 21 to 26 centimeters long, horizontally through the carefully twisted hair on the top of the head, so that the ends project on both sides.

The Japanese manufacture also for the foreign market, in Nagasaki particularly, all sorts of articles, as round table-tops, baskets, dishes and plates, bracelets and napkin rings, cigar cases, and various others from the real and factitious tortoise-shell, and adorn them besides with gold lacquer painting, in which of course the long ground-work process of common lacquering is omitted. Inlaid work of tortoise-shell, the so-called *Boule-* (Buhl- or Bool-) work, which for last two centuries had been so conspicuous in the finer furniture of Europe, is little known in Japan, and it is somewhat striking that neither here nor in China have horn or tortoise-shell been used for combs.

In working up the tortoise shell in Nagasaki, the file, small saw and chisel are used, and especially iron pincers with smooth broad jaws. Each workman sits before his little charcoal furnace in which he heats the tongs. He cools them somewhat in water before using, and welds the two plates of tortoise-shell, which are sharpened at the edges, heated and laid one over the other, fast together. Rings, plates and other articles are pressed in wooden moulds after the material has been heated. Steam seems not to be used in the process.

Factitious tortoise-shell is much used. It is made of bright-coloured horn or Tsuno from China. The tortoise-shell-like etching of horn seems to have been known and practised here much earlier than in Europe.

Ao-gai-zaiku, Mother-of-Pearl Work.

Pearls and mother-of-pearl consist of thin laminæ of lime with little organic substance. But while they are found in concentric layers in the pearls, in the latter they follow the horizontal direction or trend of the shell, yet in such a way that even in flat mussel and snail shells they lie somewhat inclined to the surface. The lustre proceeds from the reflection of light, the iridescence or play of colour from the interference of the rays which are reflected from the projecting edges of the laminæ or blades and the somewhat deeper parts. The colour-change or iridescence of mother-of-pearl consequently is a phenomenon of interference which inheres in the structure.

Furniture inlaid with mother-of-pearl is very popular in Turkey, and throughout the entire Orient, but particularly in Further India and China. In Japan it is used mostly for decorating lacquer wares. It is a product of the country, called Ao-gai (Awo-gai), is used in thin sheets, is distinguished by its magnificent iridescence in all the colours of the rainbow, and is obtained mainly from the smooth inside of the larger varieties of Ear-shell (*Haliotis japonica*, Reeve, *H. gigantea*, Chemn.), called Awabi. A still more valuable sort goes by the name of Ao-gai-Magai, *i.e.* imitation Ao-gai. It is formed of laminæ scarcely three centimeters broad, and is said to come from the Riu-kiu islands, from a kind of Nautilus. The shell of the Sazaye (*Turbo cornutus*, Chemn.) also yields mother-of-pearl.

The polishing of the mother-of-pearl, as I observed it in Nagasaki, is not scientifically conducted, since there is no facilitation of the work such as is afforded by the heavy grindstone, revolving vertically round its axis. The thick, curved outer edge of the Haliotis shell is first removed up to the row of holes by means of pincers, hammer and chisel; then the remaining part is ground on a fine grained sandstone, sprinkled with water, till only a thin transparent lamina remains. It is a very wearisome work, and one man can polish only eighteen pieces in a day. Each sheet costs from 2 to 6 sen, according to the size and fineness. These thin sheets or plates, as well as the mother-of-pearl dust of various degrees of fineness obtained from the waste, are now used by the Ao-gai-shi or mother-of-pearl workman, for decorating lacquer wares, as has been partly described on pp. 364, 365, the transparent laminæ are laid on the pattern, and the design or a part of it, is traced through with the India-ink brush. In painting flowers, leaves and other coloured parts, the rubbed colours are laid on the sheets with hot glue-water. When dry, it is coated with a weak solution of glue, and then covered with silver-foil. After again drying, the figures (flowers, leaves, or whatever may be the design) are cut out with a hollow chisel. They are then glued on the coloured side to the lacquered articles, such as cabinets, little chests, plates, vases, etc. The rather rough ground was previously treated with ochre and lampblack.

When the whole design is completed by gluing on of the many-coloured mother-of-pearl leaves, the interstices are filled up with black lacquer, and in conclusion the whole is varnished with a transparent lacquer, and polished, as has been described in treating of other lacquer wares, and the Ao-gai-zaiku or mother-of-pearl work, demanding so much time and patience, is finished. The under layer of silver-foil seems to bring out the figures, for which purpose tin-foil cannot be substituted.

Besides this Ra-den or Mosaic work with thin sheets of mother-of-pearl, thicker pieces are ground and engraved as a flower, an egg or some other design, and made to serve, like ivory, as an inlay in raised gold lacquer work. The making of brooches out of this material, however, and of turning buttons and other articles of jewelry on the lathe, is scarcely known.

The Japanese designated Kin (gold), Gin (silver), Ruri (lapis lazuli),[1] Sangoju (coral), Meno (agate), Sui-shô (rock crystal), and Shin-ju (pearl), after the precedent of Buddhism in China and Corea, by the Sinico-Japanese expression Shippô (Jap. Nanatsu-no-takara), *i.e.*, "the seven costly things." Of these seven, lapis lazuli, fine coral and pearls are as little found in Japan as most of the prominent precious stones. They are also very little imported, for Japanese taste is distinguished from that of the Aryan orientals and the Turks essentially in this, that it places little stress on precious stones generally, and quite as little on finger rings, bracelets, brooches, and other ornaments in which these precious stones are used. Jewelry was neither made nor worn in Japan.

The principal ornamentation of the Japanese girl, apart from the dress and broad girdle, is concentrated on the head. It shows itself besides, in the paint on the lips, throat and cheeks, especially in the careful dressing and ornamentation of the lustrous black hair with pins (Kanzashi and Kogai) and Kanoko-chirimen.

The most valuable stone which Japan furnishes has always been the rock crystal or Sui-shô (Seki-ye), *i.e.* "crystallized water." The appearance of the Sui-shô-tama or Sui-shôrin, *i.e.* balls of rock crystal, which are cut out of colourless crystals reflecting beautifully the forms of objects around, is an especial delight. Their price increases with the purity and size of the stone, so that those having an average diameter of from 6 to 10 centimeters, cost from 300 to 600 yen. The European imitations of these costly rock-crystal balls in glass (Biidoro), are easy to distinguish by their more or less strong bluish coruscation, their small conductibility of heat—in consequence of this, they feel less cold—and by their greater softness. Nevertheless they have much influenced the esteem and lowered the price of the genuine, and on this account have set back very much the importance of the whole industry. Therefore, it has happened as in Europe, since the development of the glass industry and evidently through it, that the polishing of costly vessels of rock crystal, such as are found frequently in old collections, and which in the Middle Ages formed an important branch of art industry, has been almost entirely given up.

The Japanese appear to have employed hollow-grinding only in the softer marbles, but not in rock crystals. They still principally make balls out of these (also for the valuable Buddhist rosaries or Jû-dzu), lenses and dice, as well as beautiful watch charms of various forms, buttons and other little articles, which can be bought, not only in the factories, but also in Yokohama, Kiôto and other cities.

[1] Ruri is sometimes translated emerald. It signifies, however, "ultramarine blue," and points decidedly to the amorphous lapis lazuli.

Beautiful little tufts of hair-like amianth are often found in Japanese rock crystals. These are then called Kusa-iri-sui-shô, *i.e.* grass-holding crystals, and the tuft of earth-flax itself is called Kusa, grass, designations occasioned by the form and colour of the enclosure; for these resemble strongly tufts of grass which have been enclosed by clear ice.

Murasaki-sui-shô, *i.e.* violet rock crystal, or amethyst, is seldom found in Japan of so great beauty as to warrant its use as an inferior precious stone. Cha-sui-shô, *i.e.* tea-coloured rock crystal (smoked topaz), appears very often. The Japanese rock crystal excels the Chinese in clearness and transparency. It is found in many provinces, but Kôshiu with the Kimpuzan, Mii-take, Komaga-take and other mountains have an old reputation as the chief depositories. Sui-shô, and Amabata-ishi belong, like grapes, to the Mei-butsu or celebrated products of Kôshiu.

Garnet-sand (Almandin) is used for polishing Japanese precious stones (rock crystal and agate), also spectacles. It is found in several places in Japan, but especially in a long extended mountain ridge, the Kongô-san in the province of Kawachi near the boundary of Yamato.[1] This reddish brown garnet bears the name Kongô-sha, *i.e.* "very hard sand," or "diamond sand," and comes in the form of little round grains, which under the microscope show more or less distinctly the garnet structure. It is brought to market by way of Ôsaka.

In Kôfu, the capital of the province of Kôshiu or Kai, I found in the autumn of 1874, two establishments for polishing rock crystals. Most of these, however, are said[2] (according to A. Schenck) to be at the foot of the Mii-take at Kurobara, a day's journey farther north. The apparatus for polishing in Kôfu was of a primitive, simple kind. Bent and hardened iron rods in the shape of longitudinal sections of hollow cylinders, together with garnet-sand and water, served for polishing the balls. The garnet-sand and water were spread over the iron spout, and the piece of rock crystal was rubbed backwards and forwards in it. The garnet-sand was separated into seven kinds according to the fineness, by sieves. The polishing began naturally with the employment of the coarsest, and finished with the finest sand.

Meno or Meno-seki, the agate, is the best known of the other precious stones of the quartz family, and is polished in the same manner as the rock crystal. I have not seen these in the places where they are found and polished. Lyman, on the other hand, mentioned such at Oniu in Echiu, Tamatsukuri and Yumachi in Idzumo. He found in both the last-named places, agate,

[1] The Orographical and Hydrographical map in the first volume of this work gives the situation of the Kongô-san westward from the Yoshino-gawa.

[2] "Reise von Kôfu nach den Quarz- und Bergkrystallgruben bei Kurobara." "Mittheilungen der deutschen gesellschaft Ostasiens," 8 Heft. Yokohama, 1875.

chalcedony, cornelian, green jasper, and smoked topaz, which were worked up into pretty little ornaments.[1]

Soapstone, Jap. Rôseki (wax-stone), and In-seki (seal-stone), is found principally in Bizen, in simple greyish white and also coloured varieties. It is much worked up into seals (Ingiô or In) but for this purpose the Chinese Agalmatolite (To-Rôseki) [2] is preferred.

7. Metal Industry.[3]

Prefatory Remarks.—The Working up of Iron into Swords, Armour and Objects of Art.—Embossing of Cast Iron.—The use of Copper.—The most important Alloys of Copper.—Japanese Bronze.—Patina.—The use of Bronze in the Household, and the Buddhist Religion.—Magic Mirrors.—Gold and Silver in Japanese Industrial Art.—Bronze Analysis.

Numerous indications and historic statements which cannot be doubted, tell us that the Japanese people were acquainted with the most important metals in very early times, and have made great progress, especially with their preparation, since the 6th century of our era. The finding of pre-historic bronze weapons, like arrow-heads and swords, copper rattles and bells, and iron articles of various kinds, we must leave to the further study of the antiquarian. Japanese art industry in all its branches, including that of metal industry, was not really developed until Buddhism pushed hither from the continent, with its new ideas.

In the first half of the 8th century, at the time of Shômu-Tennô, the ability to work skilfully in metals generally, and especially in bronze, had already reached a high stage. This is seen in the idols, vases, censers, and other articles which the old celebrated temples at Nara, Kiôto and other places have preserved from that time. The influence of China and Corea, and the advancement of industry by Buddhism, are here also unmistakable.

This stimulus on the part of religion to metal industry decreased with the imperial power and the development of military despotism and feudalism. (See vol. i. p. 226). In the civil wars which the parties of the Taira and Minamoto carried on in the 12th century, as well as others which followed later, the forging of iron weapons and armour, became of greater importance than the casting of idols and vessels of bronze. Whoever could make good

[1] Lyman: "Geological Survey of Japan. Reports of Progress for 1878 and 1879." Pp. 35 and 58.

[2] Their external similarity to variegated soapstone, in colour and veining, is evidently the reason why the Japanese apply the name Rô-seki to serpentine, and also to coloured marble (p. 313).

[3] Kane = the metal; Kane-mono = the metal-ware: Kane-dzaiku = the metal-work.

swords stood at once higher in the general estimation than any other tradesman; his industry flourished when all others were laid low.

When the dynasty of the Tokugawa-Shoguns was firmly founded by Iyeyasu and his next successors, and the land was assured of peace, the other branches of metal industry, as well as of industrial art in general, became once more important. The disturbance which it suffered twenty years ago, through the setting aside of feudalism and the restoration of the Mikado government, has had no lasting effect except upon the forging of weapons. On the other hand, metal industry has made new openings for itself in many of its artistic branches, and shows in these remarkable progress, as will appear hereafter more especially in the instances mentioned.

There is scarcely any kind of metal ornamentation or decoration, with the exception of galvanizing, which the Japanese had not known and practised before the opening of the country. In their more eminent accomplishments they had already won the admiration of European connoisseurs. Precious metals, copper, bronze, and cast-iron, however different their properties may be, all yield to the skilful hand of the Japanese, and to his manifold little art-conceptions, which effectively supplement the simplicity of the tools. His decorations of iron and bronze belong notably to the most costly that can be accomplished in this direction. The wonderful skill with which apparently insurmountable difficulties in damascening, chasing and other work are overcome, surprises us no less than the great ability to work effective colour combinations, and the means of their representation.

Before I proceed now to the description of the chief accomplishments in the several divisions of Japanese metal industry, I will explain them briefly in the interest of such readers chiefly who may not understand the customary art expressions. The most common working utensils which are used by the Japanese in the various kinds of metal decoration are the following: 1st, the anvil, Kana-shiki or Kana-toko; 2nd, the tongs, namely: *a*. Yattoko, the pincers; *b*. Kana-hibashi, the fire tongs for holding hot metals; *c*. Kugi-nuki, the nail tongs; 3rd, the iron hammer, Kana-dzuchi (Sai-dzuchi is the wooden hammer which is used in the chiselling of wood, and other softer substances); 4th, the file or Yasuri; 5th, the chisel or Nomi, in many forms and sizes; 6th, the burin, bent graver or Tagane, a little piece of iron from a finger's to a hand's length, generally in the shape of a nail; the upper end a little enlarged like a head, the lower either pointed or sharpened like a chisel, and always edged with steel. The burin is used in engraving, chasing and inlaying, and is one of the simplest but most important of the tools of this industry. The punch is a kind of burin whose steel end has other forms and is often provided with figures. It is used in the chasing of metals; 7th, Ko-gatana, a small knife.

The various forms of decoration which the Japanese employ with metals are called casting, embossing, beating, turning, chasing, engraving, inlaying, damascening, encrusting, plating, enamelling, and colouring.

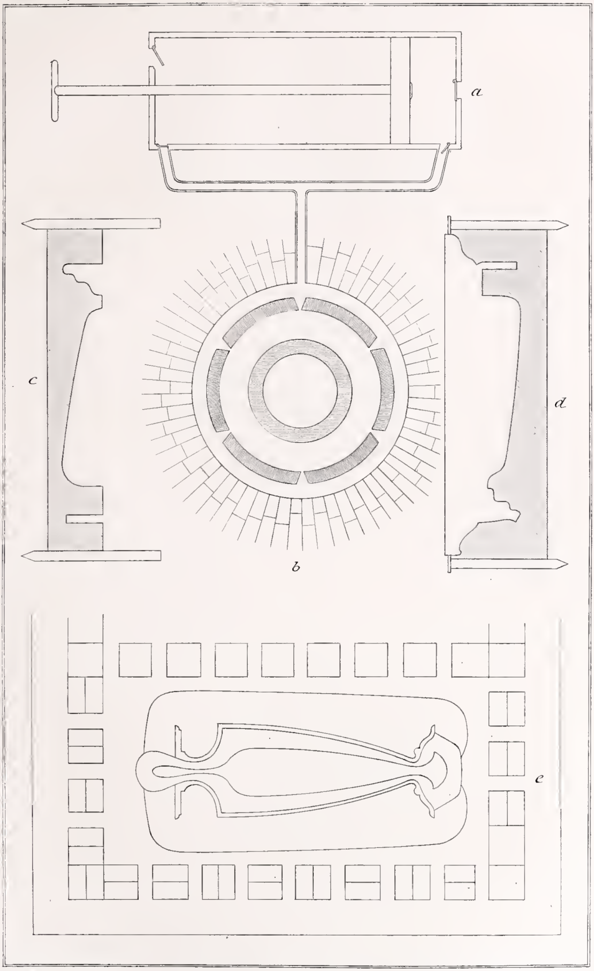
Casting, Jap. Iru. (I-mono, the casting). Plate XV. shows in *b* the lower cross-section of the common, small, smelting furnace ; in *a* that of the box bellows. The air of the latter is forced in six places into the fire-box in which charcoal is brought to a glowing heat. These places surround the smelting furnace, which is made of fire clay. Figure *e* shows the cross-section of the clay mould of vase with its interior, which has been beforehand turned on the patterns *c* and *d*. Such moulds are, of course, duly prepared before each casting. The results in iron, and especially in bronze casting are astonishing when one considers these simple arrangements. At the Vienna Exhibition was seen for instance, a group of flying birds, which appeared separate from each other, and still were formed at one casting.

Embossing, Jap. Uchi-dashi or Uchi-age. The decoration of bronze in relief is accomplished either in the casting of the subject, or by turning and chiselling, or finally by embossing, French Repoussé-work. The last consists in forcing the metal from the inside outward, generally with the aid of the punch. Embossed work can, of course, be executed only in sheet metal. In Japan it is made principally in Hiroshima and the three capital cities, but is far less important than other modes of decoration.

Beating, Jap. Tataku or Utsu is the name given to the hammering of cold metal into sheet form on the anvil. The skilfulness is shown in the finished products (for example, a silver or copper vessel), chiefly in the even distribution and conformity of the marks of the hammer or Tsutchi-me (hammer eyes). The well-known silversmith, Tiffany of New York, furnishes beautiful beaten work of this kind which excels even the finest of Kiôto.

Turned work or the Rokuro-saiku is generally done on the turning lathe in cast bronze. It has become more and more the custom in modern times to produce the decorations in relief, not in the casting, but by sculpture (Horu). The article, a vase for instance, is cast smooth but with very thick walls. The bronze sculptor, or Hori-mono-shi, draws the ornamentations which are to protrude above the ground, and next cuts away to the required depth the superfluous metal around the outlines by means of chiselling and turning. He then applies himself to the projecting parts, and forms them just as the sculptor or the wood-carver forms his rough block. What he loses by this in time he spares himself in the preparation and simplifying of the casting.

Chasing, Jap. Horu and Hori-age, is the name given to the afterwork with the chisel, burin, and file applied to the relief obtained by casting, embossing or sculpturing. By chasing, the seams of the casting and other accidental unevennesses are removed. Folds, furrows and angles are developed, or better brought out



Verl. v. Wilh. Engelmann, Leipzig

Lith. Anst. v. Werner & Winter, Frankfurt a/M

APPARATUS FOR CASTING METAL.

a. Box-bellows, b. Cross-section of a smelting-furnace, c. d. Model, e. Mould.

and in general, the imperfections of the first, coarse work are overcome.

Engraving, to carve in, to incise, is called in Japan also Horu, but likewise Kiri-tsuke, and is nearly related to chasing. It is done with the knife (O-gatane) and the bent graver (Tagane), and usually serves for the decoration of flat surfaces, not of raised work. Hori-mono is the name given to every kind of graven or chased work, and the article thus decorated is called Hori-mono-zaiku.

Damascening, Japanese Zogan (German Tauschirung, French Damasquinure), is the name given to the inlaying of wires and fine strips of gold and silver in the furrows of baser metals. Iron, steel, bronze and copper especially are damascened. The ornamentation stretched out beforehand must be engraved according to the pattern with the burin, or hollowed with the chisel. The furrows which are produced with the former, have in the cross section the form of a swallow's tail, or are made "under cut" as the bent graver is held in receiving the blows of the hammer, first vertically, then inclined, once to the right and once to the left.

In this way both the outer edges of the furrow, which grows larger towards the inside, are beaten back, welt fashion. They are then filed off smooth, and the prepared piece of precious metal (wire or plate) is laid in the furrow and driven in with a hammer. The Japanese distinguish three kinds of work according to the manner in which this is done, as they do in gold lacquer work, as follows:

a. Taka-zogan, *i.e.* raised damascene work in which the gold and silver, like the *à jour* precious stone in its setting, for the most part projects over the furrow.

b. Hira-zogan, flat damascening in which the inlaid precious metal does not project over the surface of that metal decorated with it.

c. Nuno-me-zogan, *i.e.* damascening in meshes. That variety of Hira-zogan which is used chiefly as a universal surface decoration, such as plate XVII. shows on both sides of the vine border, as well as the clouds in fig. 17, receives this designation. The cobweb on the bronze vase, plate XVIII., and the handle ornament on fig. 15, are specimens of simple Hira-zogan, while raised damascening is what we see in the girls' figures, and other forms in plate XVII., as well as in several of the following illustrations.

The expression damascening is now used generally as a synonym for inlaying. In its secondary significance, the etched mirror-like decorations of silky lustre on steel and iron are understood.[1]

[1] In Europe, the beginning of the art of inlaying is traced back by antiquarians generally to the Celts. I do not share this opinion, and think the artistic sense and ability of this people was too little developed, and that the discovered works attributed to them do not originate with them, but with the Romans. These latter certainly understood and practised the inlaying of iron weapons and armour when they came into contact with the Celts. Proofs

Incrusting, or incrustation, is the name given in art industry to the decoration inlaid in the surface or crust of an article. Thus, intarsia work, enamelling and damascening are all varieties of incrustation.

Plating, Jap. Kin-kise and Gin-kise. The covering of a common metal with gold or silver in sheet form, where the precious metal is made fast to the foundation by hammering, pressing or rolling, is called by this name. The inside of the copper-box (fig. 16) was silvered by plating.

The last chapter of this section will give all necessary details concerning the metal decorations of the Japanese by means of enamel (Shippô), *i.e.* opaque coloured glassy flux, while the equally important subject of patina-work or of colouring (Iro-tsuke) will be explained in the section concerning bronze work.

Iron, Tetsu or Kurogane.

The consumption of iron of all kinds has grown so enormously since the opening of Japan, that the home production has not been able to keep pace with it, and the average yearly importation, since 1868, mounts up to nearly two millions of yen. But even in earlier times, during the long rule of the Tokugawa, the iron produced in the country itself did not suffice for the demand, so that China and Holland were obliged to contribute to its supply.

The Japanese smithing has been developed chiefly in making weapons and armour, also in casting and decorating cast-iron water kettles, whereas its accomplishments (apart from the hardening of steel) in the manufacture of all those little tools and utensils used in daily life and handicraft, cannot be very highly valued.

Among the nations of Eastern Asia the Japanese were known as skilful workers of iron, which their celebrated Katana-kaji, or armourers, transformed into famous weapons of excellent steel. They produced swords by which one could cut through iron nails without nicking the blades in the slightest. These swords were as celebrated in Eastern Asia during the Middle Ages as those of Indian steel, σίδερος Ἰνδικος (Arrian), and the polished weapons made out of this material in the Persian Empire of former times.[1] Magnetic iron, in the form of ferruginous sand, was the raw material in both cases. Its reduction is carried on even now in Japan, in small smelting furnaces with charcoal, occupying three

of this exist in many collections of Roman antiquities. I remember, for instance, one—a Roman sword, inlaid with silver, at the Museum at Mayence, that was found in the Rhine.

[1] On the plateau of the Deccan, especially in Hyderabad near Dundurti and eastward from Nimal, magnetic iron was obtained, from which the Indian steel was made which furnished the celebrated Indian and Persian cut and thrust weapons, as well as the Damascus blades.

days in the process, as for example, at Anegawa in Idzumo. Steel and iron are obtained in this way at the same time.[1]

The sword, the most beautiful, most valuable, and the most dreaded weapon of Japan during the feudal times, was, according to the expression of the Iyeyasu, "the living soul of the Samurai." To wear the sword was his greatest privilege. He was trusted with it even when a boy, and carried it with him on his way to school (see vol. i. p. 327). The oldest Japanese sword, Tsurugi, or Ken, was carried crosswise over the back, and brandished with both hands. It was a straight, heavy weapon, with sharp edges on both sides, nearly a meter long, and from six to seven centimeters broad. As these were later made half the length and somewhat shortened, another weapon, the Katana or common sword of the Japanese, was devised, with an edge which is slightly curved toward the end. The Samurai carried this either alone or with a second smaller, dagger-like sword, on the left side of his girdle. These smaller weapons were known by the names Wakizashi, and were in later times shortened to 29 centimeters (nine and a half inches) and used in the Harakiri, or disembowelling.

The forging and polishing of swords was a wearisome work, demanding much skill and practice. Hütterott especially gives particular details concerning the various methods of combining the hard steel with the soft, elastic iron. The tempering (Yakiba, from Yaki, to burn, and Ha, edge) of the edge is carefully done in the charcoal furnace, the softer backs (Mune) and the sides being surrounded up to a certain point with fire clay, so that only the edge remains outside. The cooling takes place in cold water. It is in this way that the steeled edge may be distinguished clearly from the back, by its colour and lustre. The backs of knives, axes and other weapons are united to the steel edge either by welding on one side, or by fitting the edge into a fluted groove of the back blade, and welding on both sides.

Toward the end of the 15th century the occupation of the artist was united to that of the smith. Then they commenced to pay great attention to the mounting of the blade. In this work Tsuka, the hilt, Tsuba, the guard on the hilt, and Saya, the sheath, are brought especially into consideration.

The wooden hilt of a Japanese sword is about 15 centimeters long, in the cross section a long oval, covered with grained shark-skin or other decorations, and furnished further with the Me-nuki, two little metal ornaments, each one of which is fastened nearly in the middle of one side. At one end of the handle toward the blade is an oval copper or bronze plate, the Habaki or throat; on the other end is the Kashira, the head, or Tsuka-gashira, a metal cap. Lengthwise in the handle are two slots through which a strong silk cord, almost a centimeter broad, is threaded. This is wound around the whole handle in such a way that its two halves connect

[1] See Lyman: "Geological Survey of Japan, 1878 and 1879," p. 63.

closely on the two sharply arched sides, but cross each other over the broad sides so that rhomboid meshes are formed, through which the decorations of the handle, including the Me-nuke, appear.

The sword-shell, or guard, Tsuba, is as old as the sword. It is an oval metal plate from one to two millimeters thick and about six centimeters in diameter, with an opening in the middle to admit the blade of the sword. A second opening at the side serves for the fitting in of a straight knife, the Ko-dzuka, whose blade has been made to lie in an outside furrow of the sheath, with a groove for the point. There is often a third perforation in the opposite side of the guard, through which the Kô-gai, or "hair-pin" was put.

Saya, the sword sheath, was usually made out of the wood of the Hô-no-ki (*Magnolia hypoleuca*) protected and decorated by coats of lacquer varnish. The greatest luxury in the metal decoration of sword guards, hilts, and ends of the Ko-dzuka, was developed in the 15th century, the time of the Ashikaga Shôguns. This branch of art-industry "has given to Japan its thousands of skilled workmen and its scores of famous masters." [1]

As has been said on p. 426 the iron industry, in so far as the equipment of warriors was concerned, received its great impulse during the struggles of the Taira and Minamoto (see vol. i. p. 228). Skilful sword-cutlers gained for themselves high social position, and won immortal glory and fame with their swords. Kiôto, Ôsaka and Kamakura were their chief seats; in later centuries also Okayama in Bizen, Sakai in Idzumi, Seki in Mino, and Tôkio.

Masamune, who lived in Kamakura, about the year 1290, was especially highly esteemed.[2] His name became an appellative in the sense of most perfect workmanship, and was later bestowed on the celebrated sculptor Jôchô, at Nara in Yamato, a distinction enjoyed by his descendants for six generations.[3]

Many smiths acquired great skill also in making the Gusoku or armour, especially the Kabuto (helmets), Kusari-katabira (chain coats or mail) and the Oke-gawa or breast armour, which superseded them later. Among these Yoroi-shi or armour-smiths, the family Miyôchin has especially distinguished itself for many

[1] See W. Anderson, in Murray's "Hand-book of Japan," 2nd ed., p. 115.

[2] Whoever wishes to learn more of the history of Japanese swords is referred to the following treatises.

1. "The Sword of Japan," by Thomas McClatchie, in Transactions of the As. Soc. of Japan. Vol. ii. 1874, p. 63 ff.

2. "Die Japanischen Schwerter," von G. Müller-Beeck, *Zeitschrift für Ethnologie*, 15. Bd. 1882, p. 30 ff.

3. "Das Japanische Schwert," von G. Hütterott. "Mittheil. der deutsch. Gesellschaft Ostasiens," 33 Heft, 1885.

[3] See W. Anderson, in Satow and Hawes: "A Hand-book for Travellers in Japan." 2nd ed. London, 1884, p. 103.

EAGLE IN WROUGHT IRON. FROM MIYÔCHIN MUNEHARU. ORIGINAL IN SOUTH KENSINGTON MUSEUM.

[*Page* 516.

generations, from the 15th to the 18th century. The eagle in the Kensington Museum, which is said to have been forged by Miyôchin Muneharu in the 16th century, and of which a woodcut after a photograph appears on plate XVI., belongs to the most admirable products of their art.

A large label attached to the work contains the following statement. "Model of an eagle. The bird stands with outspread wings upon a rock, and is made of numerous bits of iron, some cast, others carved or hammered and chased. It is the work of Miyôchin Muneharu, a celebrated Japanese metal-worker of the

Fig. 15.—CAST-IRON KETTLE, WITH INLAID WORK.
(Original in Royal Industrial Art Museum, Berlin.)

16th century. The width of the wings measures four feet four and a half inches (133 centimeters). Bought from Mitford's collection for £1,000." [1]

The Tetsu-bin or cast-iron kettle, which is to be found in every Japanese house for boiling the water for tea, is the only one

[1] In the year 1881, in company with a learned Japanese, I visited the Kensington Museum in London, and with the permission of the directors undertook

among all the iron house utensils which is often artistically ornamented. The cover is usually made of bronze, rich in copper, and sometimes the handle also. Most of the Tetsu-bin are cast in the three capitals, and are sometimes ornamented with inlaid work or with enamel. Among the older, richly decorated kettles, those of Kin-ju-do in Kiôto and of Riobundo in Ôsaka are most generally found in collections.

Fig. 15, p. 433, represents such an iron kettle. It shows above the out-jutting rim for holding it on the tripod, a rough surface, which looks as if hewn out of a rock. Tablets of copper plate surrounded by thick silver wire are inlaid in this surface. These copper tablets were previously inlaid with gold and silver. The forged iron handle is decorated also with inlaid work, likewise the dark copper cover. On the copper plate in front, resembling an out-spread fan, is the blooming Sakura with the Uguisu, *i.e.* the Japanese wild cherry-tree with the Japanese nightingale, in silver and gold. A narrow gold plate encircles the spout in the form of a ring.

Zôgan, or Inlaid Work on Iron.

Although inlaying in iron was known even at the time of the Kuwammu Tennô (782 to 807 A.D.), still it was not generally employed till the 16th century, when, under Ota Nobunaga (1542 to 1582), the iron breast armour, Jap. Oke-gawa (literally, tub-bark), the armour shirt or Kusari-katabira, of woven wire, had become a part of the warrior's armour. It then grew to be more and more the custom to decorate these pieces of breast armour and the helmet also with silver and gold inlay; just as in Europe and especially in Spain, during the Middle Ages, armour and weapons were often made very costly by this inlaid work. The finest Japanese armour was made in the time of Taiko-sama, that is, during the second half of the 16th century.

More surprising than the inlaid work on the forged iron armour and weapons, is its direct employment on cast iron Tetsu-bin, vases and other articles. As is well known, the cast iron cannot, on account of its hardness and brittleness, be worked with the hammer, chisel and burin. The way in which these properties are lessened by the reduction of the carboniferous contents has been

an examination of the origin and age of the Japanese metal articles. The glass case which covered this masterpiece, the eagle, was opened, the bird taken down from its pedestal, a rock of strong sheet iron, and thoroughly examined in all its parts; but we found no inscription, name, or sign, which would indicate its origin. We have also not been able to trace the history of this remarkable piece of art-industry, which Mitford, the former English Secretary of Legation in Japan, had brought with him. We then turned to the bronzes. Scarcely the third part of these bore name and date. But from them it was apparent that almost all these vases and other articles designated as "old Japanese bronze" were made in this century.

observed by Lehmann and Wagener in Kiôto.[1] It is a peculiar decarburising process, by which the surface of the kettle or pot receives a structure like to that of soft iron or steel, and can then be treated in the same way as in the Zogan-work on forged iron.

The process of decarburisation of the surface is called Yakeru (to burn), and is performed with primitive apparatus. Old damaged rice kettles out of which the bottom has been knocked serve as ovens. These are plastered over on the inside with a fire clay (Oka-saki-tsuchi and sand mixed in equal parts), so that a cylindrical space of the size of the hole in the bottom, remains open. The Kama or kettle thus prepared, is turned over upon a thick plate or slab, three or four centimeters thick, made out of the same fire-proof material, which serves as a grate, and is perforated like a sieve for this purpose. In order to give this plate greater firmness, it is bound around with an iron band. The holes have a width of about 1·5 centimeters. In order to give the air free play, several stones are laid under the edge of the slab. Then the Tetsu-bin to be burned, whose outside has been carefully cleaned beforehand from dust and sand, is placed in the Kama, directly on the grate.

The difference in size between the Kama and Tetsu-bin must be such that a space of at least five centimeters remains open around the latter. This open space is then filled with the best charcoal in pieces the size of a nut, till the Kama is filled to the rim, when the coal is kindled.

In order to increase the draught, two or three Kamas filled in the same way are set one over the other, forming a kind of chimney. When the coals have ceased glowing, others are put in, and when the second instalment is burned out, the Tetsu-bin are taken out and turned upside down (with the opening underneath), set again in the Kama and burned twice in this position. Under favourable circumstances, the surface is now sufficiently soft and tough, as is ascertained with a file. It is often the case that the furnace must be heated ten times. After the cooling the decorations are then carved as in forged iron, without danger of breaking the edges, or recoil of the burin.

Until some twenty years ago, the decoration with such inlaid work was limited to places on iron kettles. At that time several skilful workmen, formerly armourers of Kiôto, especially Komai and Iyenori, turned their attention to the work, and have developed since then this branch of art industry in an astonishing manner, decorating large vases, smoking utensils, plates, dishes, and other articles of cast-iron with remarkable artistic skill, hitherto unknown The heliotype of plate XVII. represents a cast-iron vase of Komai in Kiôto, adorned with such Zogan work.

In the summer of 1875 I obtained from a dealer in Kiôto the

[1] I am indebted to the kind communications of these gentlemen (Engineer Lehmann and Dr. Wagener, both now in Tôkio) for the items given here.

first pair of such vases—a work which at that time, in Tôkio, attracted great attention among Japanese and foreign connoisseurs. They are now in the Royal Industrial Art Museum in Berlin. Later on a second pair with similar work was sent to Germany, acquired by Dr. von Brüning, of Frankfort on the Main, and presented to the Industrial Art Museum at that place. These vases are designated by the authors as "the united work of Komai Yoshitaka and Komai Yoshihiro, inhabitants of Kiôto, province of Yamashiro." They are among the most beautiful works of this description, although they are the first of the above-named masters. The four fields, two on each vase, represent silk culture. The picture before us shows the end of the process. One girl is busy with the hurdles upon which the worms have been grown ; a second collects the finished cocoons ; a third brings them away ; a fourth sits at the old simple reeling apparatus, a little stove with a coal fire, on which the water is being heated in the iron pan placed above it. She has thrown in a handful of cocoons and is about to reel off the silk threads. A fifth girl is busy hanging up the strands of reeled silk to dry. The fineness of the embossing goes so far as to give the pattern of the clothing, which is recognisable even in the small scale of the picture. Many of these newer Zogan-works on cast iron are rendered more prominent through the steel blue or dead-black groundwork, a peculiar kind of "Niello," which is made of lacquer putty, or Shakudo, and produces an effect like the works of Zuloaga of Madrid, whose name is known to every friend of art industry and visitor at the great exhibitions, by its magnificent inlaying of iron.

Copper (Aka-gane, Dô), the most widely distributed, and next to iron the most important metal of Japan, is said to have been found here first in 708 A.D. But without doubt it was known to the inhabitants much earlier, as is indicated by prehistoric discoveries. Among these and side by side with stone weapons and coarse earthen vessels, are also copper swords and small round bells (Suzu) of copper plate, and other bells (Tsuri-gane) of considerable size.[1] Copper probably came first with Buddhism from China and Corea to Japan. It is certain that it has served for the ornamentation and outfitting of Buddhist temples and pagodas, as in India and China, in manifold forms, from the first introduction of Buddhist teaching till the present time.

If it does not play in Japanese religion and in the household so prominent a part as in India, where copper and brass vessels have served for ages the manifold purposes for which we, generally, use wooden, clay and glass ware, it is nevertheless in Japan often substituted for the earthen vessel as well as for iron, zinc and tin. Among other useful copper utensils, I mention only the Yatate or portable writing-case, in which the Japanese business man carries

[1] See Kanda Takahira ; "On some Copper Bells." "Transact. As. Soc. of Japan," vol. iv. p. 29 to 33.

PHOTOTYPE BY STRUMPER & CO., HAMBURG.

INLAID VASE OF CAST-IRON.

Original in the ROYAL KUNSTGEWERBE MUSEUM Berlin.

with him his brush and fluid India ink, the Kana-darai, the wash-dish of brass or copper, and the Yuwakashi or copper kettle for boiling water.

Copper cannot be cast like iron and bronze, because it makes bubbles and forms holes in stiffening. It is therefore worked up into wire and sheet form. It is very much used in this form for mounting fine boxes and cabinets, with holds and cramps, which are most tastefully decorated by engraving of arabesques, flowers, birds, and other things.[1]

I will give here another method of treating copper, which has not yet been mentioned anywhere else. I first became acquainted with it through the celebrated bronze manufacturer, Kanaya Gorosaburo, in Kiôto. Besides many sorts of bronze ware, he makes also small copper water-kettles, holding from a half to a whole liter, in which only the revolving knob of the cover and the two soldered handle-ears, are made of a brass-like bronze. The forms of these kettles are extraordinarily pleasing, including the handle, whose upper part is finished with a beautiful plaiting of rattan. The ornamentation of the simplest kettles consists of a lustrous dark coffee-brown patina, after whose preparation vine decorations and other light and pleasing designs are engraved upon it. The reddish brown copper colour which appears in the engraved leaves and flowers and also in the lustrous dark brown ground colour is very effective. The richer ornamentation consists of inlaying and encrusting with silver and gold. The inside of the kettle also generally receives a silver plating, as a protection against acids. The dark coffee-brown colour of copper and bronze, as I saw it on a copper Yuwakashi, is obtained in the following manner. Equal weights of green vitriol (Rôha), copper vitriol (Tampan), and sulphur (Iwô), are respectively mixed with water. The copper article is then dipped in this bath, which must be often stirred on account of the finely distributed sulphur, and then rinsed in a second bath prepared in the same way, but very much thinner. This process is repeated till the necessary corrosion is attained, which is recognised by long practice. The vessel is then brought to the Hibachi or fire-pan, and heated here on an iron grate, whose bars are from eight to twelve centimeters distant from each other, and with frequent turning. In order not to endanger the soldering, these bars are sprinkled from time to time with water in which Kariyasu (*Calamagrostis Hakonensis*, Franch. and Sav.) has been boiled. The vessel is now rubbed with a cloth, then painted lightly with Ki- (or Seshime-) urushi, rubbed again with the cloth, painted once more and now heated until the sprinkled Kari-yasu water rolling

[1] I have never observed in Japan the Indian and Persian method of decorating copper vessels, by giving them a coating of tin in which the ornamentation is engraved or carved down to the copper ground. On the other hand, the enameling borrowed from the Chinese is well known and practised. Fuller details in regard to this will be found in the last chapter of this section.

away in balls, indicates the amount of heat. The copper article is then taken from the grate with a pair of tongs and coated with a mixture of raw lac (Ki-urushi) or Seshime and lamp-black (Yuyen-sumi). It is then heated again up to the point where the water rolls away in balls, brushed over and painted anew with the lac mixture, and so on, till colour and lustre have the desired shade, whereupon the work is finished and the article is set aside for a second cooling.

Kanaya Gorosaburo told me that he obtained the same patina with bronze by a quite similar process. He maintained further that many workmen used vegetable wax instead of lac, but that such an Iro-tsuke (process of colouring) could not be recommended. It is striking, however, that the lac or its substitute is not carbonized by the heat.

Fig. 16 is a woodcut showing a copper box; and fig. 17 (p. 439) shows its cover. The box is plated on the inside with thick silver

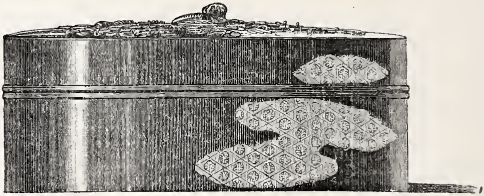


Fig. 16.—COPPER BOX WITH INLAID WORK.

(*Property of the Royal Industrial Art Museum, Berlin.*)

plate, and the outside coloured a dull greyish brown. Its inlaying of the clouds on the sides is done in gold.

The most beautiful part is the ornamentation of the cover in surface-relief, showing a hill with a rivulet winding around it. The prominent figure well placed, chased and represented for raised inlaid work (in which both the gold and silver alloys, Shakudo and Shibuichi are used) is the cock; his comb and the short tail-feathers which are seen on the wings and back are of natural copper colour; the copper tail is bronzed in blackish brown. Wings, cheek and throat are of several shades of gold-yellow, also the legs; the feathers of the back arranged like a row of tiles, are coloured silver-grey by means of Shibuichi, likewise the little chicken hurrying to the water, all except the gold-coloured legs. The artist, in order to represent the sun shining upon its head and throat, has used pure glistening silver. The Wistaria, which gives the picture a beautiful finish, has its stems and under leaves covered with light yellow gold ; the rest of the leaves and tendrils with dark yellow, the blossoms with silver, Shibu-ichi and copper. On one side of the rivulet may be seen a blooming dandelion whose leaves are inlaid with light gold and the blossoms of dark gold. The whole has a wonderful effect, full of life and force.

The following are the most prominent of the numerous copper alloys (Maze-gane), which have to be considered in Japanese Art Industry.

1. Shin-chiu, brass. This contains usually thirty per cent. of zinc to seventy per cent. of copper.

2. Kara-kane (literally China-metal), bronze. Bronze is under-

Fig. 17.—COVER OF THE BOX, WITH INLAID WORK AND CHASING.

stood now-a-days to indicate the many different alloys of copper with tin, with tin and zinc, with tin, zinc, and lead, to which antimony may sometimes be added, but in all of which copper is predominant. These bronzes serve many different purposes, and are employed both in art and for practical objects.

3. Shibu-ichi, an alloy of copper and silver, in which the latter varies from 6 to 32 per cent.

4. Shaku-do, copper, in which from 2 to 5 per cent. of gold is mixed.

Besides the common brass that is used for wash-dishes, fire-pans, hoops around large rice bowls, bindings of chests and several other purposes, an alloy is prepared, by the name of Kô-dô, of both metals, with 35 per cent. of zinc, and is worked up in a similar manner. The Japanese do not share the predilection of the Indian people for brass utensils, but they nevertheless employ great skill and care in ornamenting the few they do use. Alloys which are made up in the manner of the Indian Bidri wares, in which zinc amounts to 90 or 95 per cent. and copper forms but a small constitutent, are not known in Japan. Here, for ages past, the most various metallurgic skill and ornamentation is concentrated upon—

Kara-kane. Bronze.

This alloy has an old history. Besides serving manifold technical purposes, it has been for ages the favourite of artists, the material in which art made her first attempts and obtained her highest triumphs. Weapons and working utensils of bronze, made very hard by repeated hammering, were preferred by many nations to those of iron. So also in Japan. The oldest prehistoric metal discoveries in this country are bronze bells and arrow heads, concerning whose origin and age we can only speculate.

Bronze shares with iron and brass the great advantage of being much more fluid in a molten state than copper, and in casting to perfectly fill out the mould, and therefore to reproduce it exactly, besides presenting on cooling a close homogeneous texture. Most of the bronze alloys shrink much less than cast iron ; the decrease of volume, however, which accompanies gradual cooling has no such great influence upon the clear outline of the casting, as that shrinking which takes place in the sudden solidifying of many metals.

A further advantage of bronze lies in the fact that it is so easy to be worked upon with hammer, chisel and burin. Its hardness is similar to that of antimony and lies in most cases, as also in brass, and especially in the old copper bronzes of Japan, between 3 and 3·5. The hardness is therefore greater than that of the single constituents of the alloy, including copper. The colour, ductility, texture and hardness are all dependent on the composition of the bronze. Among all the Japanese bronzes (the old copper bronzes not excepted) which I have been able to examine I found none whose hardness equalled that of fluor spar, while (according to E. Reyer[1]) the hard bronzes of the ancient nations, which were free from zinc and lead, had a hardness of between 5 and 6. The cause of the greater density and hardness of these old bronze pieces, as axes, chisels, arrow heads, swords and other weapons, is doubtless to be found in the fact that they were made with the hammer, as castings of a similar composition do not show

[1] E. Reyer: "Hartbronze der alten Völker." *Journal f. prakt. Chemie.* Bd. 25, 1882, p. 258.

these qualities.[1] Nevertheless, the closeness, hardness, toughness and other internal properties of the Japanese bronze are not the ones by which they are especially distinguished and excel those of the Chinese, but rather their colour and ornamentation. The colours range through all the shades of brown and grey from light yellow to the finest and most effective dead black, and are distinguished by great uniformity, such as is possible only when this proceeds from a natural chemical re-action, which is dependent on the composition and not on painting.

When one considers the small technical aids which the Japanese can rely upon in his bronze work, his remarkable accomplishments in patina-work are the more surprising.[2] The dead-black bronze articles which have come in ever increasing numbers within the last few years to Europe, have especially attracted the attention of interested circles, because of their novelty and striking beauty, and have led also to thorough analyses and experiments. This has been done principally in Paris, the city which for three centuries has rejoiced in the well-founded reputation of being able to execute in bronze industry the best that Europe could offer. The researches of H. Morin,[3] Christofle and Bouilhet,[4] and E. J. Maumené[5] were particularly notable.

In Germany, the unsatisfactory state of many public bronze monuments led to thorough investigations of the formation of patina, among which those of R. Weber[6] are especially noteworthy. The collective result of all these studies may be summed up as follows :—

By the terms patina, antique patina or "noble rust" (*Ærugo nobilis*), formerly only the malachite green or blue-green efflorescence of carbonate of copper was understood, as it is often found on old bronze and copper works. This patina is always smooth, but does not cover the article evenly, as the metal always gleams through it. It is also found in modern bronze monuments, for instance in the statue of the Great Elector at Berlin, in the equestrian statue of Elector Johann Wilhelm in the market place at Düsseldorf, and in the monuments of Louis XIV. and Louis XV. in Paris.

[1] This proves at least their greater density, while another molecular arrangement must account for the greater hardness, though I do not know that this can be effected by simple hammering.

[2] G. Bousquet remarked upon this in his very interesting article, "L'Art Japonais," *Revue des Deux Mondes*, 1877, tome xxi. p. 323, as follows : "On ne saurait s'imaginer dans quelles misérables échoppes et par quels moyens primitifs ils obtiennent ces resultats."

[3] "Sur quelques bronzes de la Chine et du Japon à patine foncé." *Compt. Rendus*, t. 73, 1874, p. 811.

[4] "Notes sur des réactifs permettant d'obtenir des patines de divers couleurs à la surface des bronzes." *Compt. Rend.*, t. 72, 1874, p. 1019.

[5] "Notes sur les Bronzes du Japon." *Compt. Rend.*, 1875, t. 80, p. 1009.

[6] "Ueber Patinabildung," von Prof. R. Weber, *Dingl. Polyt. Journ.*, Bd. 245, 1882, p. 86.

This patina formation is due partly to the composition of the bronze and partly to the atmosphere. Precious copper bronze consisting of copper and tin only, is marked by it more than other kinds. A large amount of dampness in the atmosphere, and salt, together with rain and frequent washing, favour its production, while coal-dust, sulphide of hydrogen and sewer gases hinder it.

The black coating of many bronze monuments, which so often takes the place of the beautiful colour of the fresh casting, is not due usually to sulphide of copper, but to particles of coal and dust, with a small mixture of oxides. A watery solution of carbonate of ammonia put on with a brush, is excellent for removing this,[1] while the artistic production of the patina is best done by means of acetic ammonia of copper-potassium. Zinc alloys, especially brass, blacken easier than those without zinc. Copper containing arsenic also shows greater inclination to blacken.

Now-a-days patina is understood to include every accidental or intentional colouring of a metal or an alloy which differs from the original. Chemical analysis has shown that the beautiful dead-black colouring of many of the Japanese bronzes, which sets off so finely its decoration of inlaid work, incrustation and other ornamentation, is due to the lead in the alloy, which usually amounts to something over 10 per cent. and in single instances sometimes to 20 per cent. as shown in table B at the end of this chapter. Of the old bronzes only the small Egyptian idols, of which table A 5 gives an analysis, exhibit as high and still higher percentage of lead. When the alloy contains so large a mixture of lead it becomes very brittle, while the Japanese bronzes with 9 to 14 per cent. of lead, 7 to 2 per cent. of tin, and a corresponding amount of zinc, satisfy all claims, as they are easily cast, form a homogeneous mass, and by this means, as well as by their even hardness, are easy to work, which is not possible when the zinc is left out. The fine dead-black patina is produced by simple heating in a close furnace, and is caused in part by the formation of a sub-oxide of lead. Christofle and Bouilhet have shown, however, by their investigations, that a fine black patina may be obtained without lead. Their process amounted to the same thing as forming a sulphide of copper on the surface of the bronze. Brown, red and orange-yellow tints were also produced, which answered every purpose.

The Japanese have an expedient for shading according to taste the colour obtained in the tempering of the bronze, which has not been known nor tried elsewhere. This is by a kind of grass, called Kari-yasu (*Calamagrostis Hakonensis*, Fr. and Sav.), a corrosive substance of astonishing effectiveness. By boiling its roots and applying the liquid to the bronze, they obtain the said effect. An exact chemical analysis of this substance has not yet been made, but very possibly it may have some importance for our bronze industry.

[1] According to Brühl in *Dingl. Polyt. Journ.* 1882, p. 256.

We recognise in the artistic treatment of Japanese bronze vases at least three periods, which naturally are less sharply distinguished in time than in fashions, following close upon each other.

The alloys of the old bronze vases and bronze castings generally are almost always rich in copper, while lead and antimony appear as only accidental constituents. Among their manifold forms the broad long-necked flasks with cone-shaped bodies seem to rule, also the shape of a mortar, among the forms of handles the imitation of elephant's trunk. Generally the very tasteful decoration is simple, and executed mostly in surface relief by chasing and engraving. Arabesques and the elements of the Meander in manifold combinations are the ruling designs; clouds and waves and small landscapes also appear. The principal effect is wrought by well designed alternation and symmetrical arrangement. Inlaying and enamel are entirely wanting.[1] A second tendency of taste, which likewise originated in China, ruled in Japan during the last century, and is still powerful there. It is distinguishable from the first, not so much in the composition and figure of the vases as in their ornamentation. A high relief obtained by casting and chasing, with which the vases are often overgrown and overloaded in wild confusion, something like the flowers of our porcelain vases, which singly often show great artistic skill, and which are often beautifully raised up on the well designed dark background, but which confuse by their own fulness of decoration and entirely conceal the character and form of the vase.

The latest period, whose beginning does not date very far back of the time when the country was opened by Commodore Perry, indicates unmistakably great progress in Japanese bronze industry. This is especially found in the tasteful arrangement of colours and in a better sense of the right amount of ornamentation. The high reliefs do not play such a prominent part, while inlaying and incrustation are combined very effectively with chasing and engraving. Such decorations on dark bronze containing lead have been brought from the towns Kanazawa and Takaoka in Kaga and Echiu, but are now also made considerably in Tôkio. Kiôto, the old seat of Japanese industry, has not stopped behind; here too, the effort to accomplish a shading of the colours and choice

[1] These characteristics of the old Japanese bronze vases agree entirely with those of the Chinese, in the Middle Ages. I have such a one in my possession made in the 15th century. It is only 18·5 centimeters high, has in general a four-sided prismatic figure with a rectangle as cross section; it increases in width from the middle toward the top and still more toward the bottom, where it is provided with rounded corners and ends with a small foot. Elephant trunks as handles cover two-thirds of the narrow side from top to bottom. The decoration consists of two sorts of Meander figures (), which are separated by a smooth band at the narrowest place. The inscription runs in Sinico-Japanese: "Dai-Min Sen-Tok-Nen-Sei," *i.e.* manufactured in the Sen-tok period (1426-1435 A.D.) of the great Ming dynasty.

arrangement has found new ways and means. This is shown by the vase on Plate XVIII.[1] The flowers (Camellia Sasanqua) and leaves are raised from the dark brown ground in lighter colours; the bird and the spider-web inlaid with silver wire are well represented. The work is new and wrought entirely in the Kiôto style. Here bronze containing lead is less used, but there is much relief-inlaying and incrustation.

Among the useful bronze articles seen in the homes of well-to-do Japanese, are the flower vases (Hana-ike), the censers (Ko-rô), braziers (Hibachi) and mirrors (Kaga-mi), while common people must content themselves with the much cheaper earthen and other substitutes. Artistic bronze work finds its most important and many-sided employment in the manifold decorations of Buddhist temples. Here various Buddhas and other idols astonish and impress the beholder chiefly by their colossal and exceedingly fine casting, which is even more notable in a number of gigantic bells. The monuments of the Shôguns at Nikkô and at Shiba in Tôkio, lanterns and a number of smaller articles of bronze, as vases, candlesticks, censers and several others, also attract the attention and furnish proof that bronze industry has reached its highest development, principally in the service of the Buddhist religion, and that a considerable amount of copper has been used in its alloys.

Many of these prominent monuments were ordered to be cast by princes who wished thereby to make themselves acceptable to gods and men; others are presents of private persons, or the results of public collections, which the priest stimulated as much through ambition as pious feeling. So long as these last were common among the higher classes of society, the gifts for the maintenance and adorning of the temple and cloisters flowed in abundantly, while since the political revolution, the greatest indifference to all these things has been manifest.

Among the Dai-Butsu or "large Buddhas" of bronze, those of Nara in Yamato and of Kamakura in Sagami are most prominent of all because of their enormous dimensions. The Nara-no-Dai-Butsu is in a spacious temple hall, 88·4 meters long, 51·8 meters broad, and 48·2 meters high, whose roof is supported by 176 pillars. It represents Rochana (Vairochana), sitting with legs crossed under him, upon an open lotus flower. The left hand of the idol rests upon the corresponding knee, the right is raised with its back turned towards the upper arm, in such a way, that the points of the three out-stretched fingers reach almost to the height of the shoulders, while the thumb and index finger are bent toward each other. Buddha is represented in this manner as a teacher. The idol was cast between 741 and 749 A.D., by the order of Shomu

[1] This was most kindly lent me for the illustration by Herr Paechter (R. Wagner, Kunst- und Verlags-handlung, Berlin, Dessauerstrasse 2), from his rich and choice collection.

Bronze Vase from Kioto.

Wilhelm Engelmann, Leipzig.

Tennô. In 1180 a fire destroyed the head. The present ugly one was cast in 1570, at a time when art industry was in a very low state. The oldest part of the body and the lotus flower consist of plates from 18 to 30 centimeters thick, having a surface of 30 to 36 centimeters, which are soldered together at the edges with Handaro (tin-solder). The entire height of this Buddha is 16·05 meters (53·5′), the length of the face 4·80 meters (16′), the width, 2·35 meters (9·5′), the width of the shoulders 8·61 meters (28·7′), the length of the middle finger 1·5 meters (5′), that of one ear 2·55 meters (8·5′). The halo which surrounds the head has a diameter of 23·4 meters (78′) and each of the 16 figures which appear in it, a length of 2·4 meters (8′).

The total weight of this Buddha is estimated at 450 tons. In its casting, which did not succeed until after several vain attempts, copper, tin, quicksilver and gold are said to have been used.[1] If the quantity of these metals be reckoned as they are given, in kilogrammes and per centage, the alloy will be found as follows:

Copper	447,273 kg.	=	98·06 per centage
Tin	7,633 „	=	1·68 „
Quicksilver	977 „	=	0·21 „
Gold	227 „	=	0·05 „
	456,110	=	100·00

and therefore 456 tons as the weight of the metal used.

The great Buddha of Kamakura which is so often copied (see vol. i. p. 460) is not so large as that of Nara, but far excels it in artistic execution. This bronze figure represents Amida sitting on a lotus flower, but without the aureole. The nobly formed head is most symmetrically built and well proportioned in all its parts. The artist has succeeded in lending to the expression of countenance, and to the whole bearing, the blessed peacefulness of Nirvana. The hands lying in the lap with the finger tips touching each other, heighten the indications of restfulness, which are unmistakable.

This Buddha also, which was cast in 1252 A.D. by Ôno Gorôyemon, does not consist of one piece only but was put together from many plates of about three centimeters thickness, with such care and skill, that those seams only can be recognised which have been exposed by the weather during the course of time. Many of the foundation stones of the great building which formerly enclosed this monument are still preserved, and on these stood the sixty-three massive columns of Keaki wood, which supported the roof. This Buddha also consists mainly of copper. Its height is 15·11 meters, the circumference at the base 29·6 meters, and the distance

[1] I do not know the chemical analysis. As Japan furnishes no quicksilver and does not use it in other bronzes, its employment in this case is doubly striking.

from ear to ear 5·4 meters. It is said that the eyes are of pure gold, and that the knob on the forehead contains thirty pounds of silver.

The statue which is found in the temple Yaku-shi-ji at Nara is much smaller than the preceding, but is nevertheless one of the finest and most interesting bronze statues of Japan. It represents Yaku-shi (Bhâishagyaguru) and originated at the close of the 7th century. In design and execution it belongs to the most notable productions of bronze casting in Japan. To these also belong the great Tsuri-gane or hanging temple bells, of which several of the finest (as for example, that of the Zozo-ji at Shiva in Tôkio), have perished in the flames within the last twenty years with the temples and many other art treasures.

The largest of the still existing bells (Kane) is to be found in the temple San-jiu-san-gen-dô in Kiôto. This is 4·27 meters high, and 2·74 meters wide, with walls 27·4 centimeters thick. Its weight is estimated at 63 tons.[1] Several other old bells are about 3 meters high and correspondingly wide. The most beautiful and interesting of these belongs to the finely situated old monastery of the Tendai sect, in the wood not far from Mii-dera at Otsu on Lake Biwa. This great bell is said to have been made by Hidesato, a celebrated hero of the 10th century, and is the subject of many stories and legends of the vicinity. Its beautiful tones belong to the eight wonders (attractions) of the Biwa Lake. When heard on a summer evening, sounding far over the lake through the peaceful country, they make a never-to-be-forgotten impression upon the mind of a stranger.

These colossal temple bells, and a number of smaller ones, are usually decorated on the outside with Chinese proverbs, and with Ten-nin (angels in Nirvana), in rows of regular knobs, and in many other ways. Usually several dragon heads form the ears on which they are hung very low, under a scaffold and roof in the temple court. They have no clappers but are struck from the outside by a beam hanging and swinging from two ropes, in a place which was raised up in the casting for this purpose.

While some of these very old Tsuri-gane astonish the beholder by their remarkable casting and size, there are 16 smaller bells (Kane) in a neighbouring building of the temple at Nikkô which no less awaken our surprise. These are just alike externally in form and size, but when rung yield distinctly and with finest effect all the tones of two octaves.

Mirrors, Japanese Kagami, have been from olden times cast from bronze in the countries of Chinese civilization, owing to the lack of proper glass. On the back they are decorated with reliefs

[1] This bell has almost the same dimensions as the big one in Peking, which the emperor Yungloh ordered to be cast in 1406. This is said to weigh 60 tons, to be 4·27 meters high and 10·30 meters in circumference at the rim. Its surface is covered with Chinese characters.

representing mythological persons, birds, flowers, weapons and pithy expressions. This is done after the front of the casting has been polished off till from 0·5 to 2·5 millimeters thick, and finally coated with an amalgam which is composed of from one to two parts tin, and one part of quicksilver. These metal mirrors are generally circular in form with a diameter of 15·5 to 16 centimeters. There is at one side a staff-shaped handle, with which they are held.

It was known to the Chinese many centuries ago, that some of these mirrors when they reflected the sunlight on the wall, mirrored at the same time the raised figures on their backs, more or less distinctly.

These mirrors are found also in Japan. The property mentioned was long ago discovered accidentally by Japanese ladies, as Muraoka[1] has pointed out. Atkinson,[2] however, was the first to call general attention to this phenomenon, while Brewster[3] published a work on the magic mirrors of China in 1883. In modern times these mirrors have been investigated by several physicists. We are indebted especially to the larger works of Ayrton and Perry,[4] Govi,[5] and Bertin,[6] all of whom agree in the explanation of the phenomena.

It was thought formerly that the pictures and decorations at the back of the mirror plate were inlaid with some other metal, or that by beating the mirror with a hammer at these figured places a greater density was produced, or the peculiar property was attributed to the composition of the alloy itself. All these explanations have proved false on closer investigation. The analyses show that the mirror bronzes have often a very different composition, as is seen in table C.

The Italian Govi has pointed out convincingly that the peculiar property of the magic mirror proceeds from the polishing, and is accidental, but can be easily produced. It is due to the unevenness in the convex arching which the reflecting surface receives in polishing, in consequence of the uneven pressure from the back, and is entirely independent of the chemical composition. Later on Muraoka and others proved experimentally that mirrors can be made not only of bronze and brass, but also of simple metals which will exhibit these magic properties in like manner. They are shown even more beautifully than in the sunlight, when a

[1] "Erklarung der magischen Eigenschaften des japanischen Bronzespiegels und seiner Herstellung." "Mittheil. der deutsch. Gesellsch. Ostasiens," Heft 31, 1884.

[2] *Nature*, vol. xvi. 1877, p. 62.

[3] *Philosophical Magazine*, vol. l.

[4] "On the Magic Mirrors of Japan." "Proc. Roy. Soc." xxviii. pp. 127–142.

[5] "Les Miroirs magiques des Chinois." "Ann. de Chim. et de Phys." 5 Série. T. xx. 1880, pp. 99–110.

[6] "Etude sur les Miroirs magiques." "Ann. de Chim. et de Phys." 5 Série. T. xxii. 1881, pp. 472–513.

number of divergent rays fall on the mirror and are projected upon a white wall. In this way the forms of the figures and designs are seen sharply outlined in a bright light, while they are not to be found on the surface of the mirror.

Shiro-kane-dzaiku,[1] *i.e.* white metal work, is the collective name for the many small metallic ornaments which were used formerly for the decoration of swords, Netsukes, and many other purposes; but in modern times are exported and highly prized in Europe as brooches, medallions, cuff-buttons, ear-rings, bracelets, etc.; for they belong at least in part to the finest works of Japanese art. The care and skill with which these articles are chased and engraved, incrusted and inlaid, is astonishing and pleasing, and no less the extremely tasteful and effective combination and shading of colours, which our jewellers have not been able to obtain till quite recently.

SHIRO-KANE MEDALLION.

In these Japanese works, the before-mentioned alloys, Shaku-dô and Shibu-ichi, are employed chiefly. The dark blue to dead black of the first, is very uniform and is especially effective as ground work, likewise the silver-grey of the Shibu-ichi. The shading in this work, as in bronze, is best done by a decoction of Kari-yasu. Besides the two mentioned gold and silver alloys, precious metals also in their pure state are used in this work. Gotô Yu-jô, who died in 1513 at the age of seventy-eight, is regarded as the founder of this school. For a long time the art was employed principally on Menuki and Tsuba for the decoration of sword handles. Shiuraku and Temmin are regarded as the

[1] We sometimes confuse this word with Oki-mono. The Japanese give this name, however, to knicknacks of all kinds, such as little carved figures, larger than Netsukes and not bored through; also to the lacquered In-ro, or medicine boxes, and many other things.

great masters in this art, as well as in making of fine metal Netsukes.

Pure silver or gold wares, or a combination of the two, were formerly seldom manufactured. This has changed, however, since the Japanese have visited the great International Industrial Exhibitions. Lately the exhibitions in Nuremberg and other places have shown in an astonishing manner how skilful the gold and silversmiths of Kiôto and Tôkio are in treating these easily worked and most responding of all metals, and in the effect which they are able to lend to their artistic workmanship.

As an Appendix to this Section, the following analyses of Japanese and Chinese bronzes are given, together with those of other bronze castings, for the sake of comparison. I call attention to the following explanation of the tables :—

Table A. Nos. 1,2,3,4, are analyses of old bronzes from the Japanese temples, by Maumené in " Notes sur les bronzes du Japon," par M. E. J. Maumené. *Comptes Rendus*, t. 80, 1875, pp. 1009 and 1010.

No. 5 is the analysis of a small Egyptian figure of Isis, by W. Flight in the *Journ. Chem. Soc.*, 41, p. 134.

Nos. 6, 7, 8. These analyses were published by E. Reyer in the *Journal für praktische Chemie*, Bd. 25, 1882, p. 258, under the title, " Hartbronze der Alten Völker."

No. 6 refers to bronze of Cyprus in the time of Alexander the Great.

No. 7 is the analysis of an axe found at Limburg, a reddish, gold-yellow alloy, that was coated firmly and toughly with thick, green patina. It could be scarcely scratched with fluor spar.

No. 8 is the composition of a chisel of Peschiera, a mixture of deep yellow colour, and having a hardness like the preceding.

All the bronzes mentioned here, show a very complicated composition. It would be a great error to assume that they originated purposely from the weighing and smelting together of the constituent parts. The opinion of Maumené, that they have been obtained by mixtures of the ores of copper pyrites, galena containing antimony, and blend found in them, seems to me equally erroneous. The metallurgic process of the ancient nations, Japanese included, was not adapted to furnishing chemically pure metals; and thus we have the small proportions of iron, nickel, cobalt, antimony, sulphur, etc., simply as impurities of copper, tin, zinc, and lead. The same is true of the exceptions in which bronze analyses show traces of precious metals.

Table B. Nos. 1–7, are analyses of Japanese bronzes with dark patina, published by H. Morin. *Comptes Rend.*, tome 78, 1874, p. 811. "Sur quelques bronzes de la Chine et du Japon à patine foncé." The large proportion of lead which distinguishes nearly all these beautiful alloys, approaches in No. 5 to the little old Egyptian bronze figure, as given in Table A, No. 5. It is not surprising also that Morin found traces of arsenic and sulphur in most of the before-mentioned analyses, and in two of them, gold and nickel also.

Table C give the relative amounts of the metals which are used in bronze mirrors. No. 1 is the analysis of such an alloy, according to Champion and Pettet, Nos. 2 and 3 the composition of the mirror-bronzes of Kiôto, and No. 4 an analysis by Atkinson. The rest are taken from the "Annales de Chimie et Physique," t. xx., 1880, p. 136. Iyo-shirome and Tori-shirome=Antimony from Iyo and from Tori.

Table D needs no explanation.

Concerning Table E, I note that most of the analyses taken from *Dingler's Polyt. Journal* are chiefly the work of Prof. R. Weber. No. 1 is a natural bronze by Elster; 2, the composition of the "Grosser Kurfurst"; 3, Friedrich Wilhelm; 4, the Horse Tamer; 5, the Statue of Brandenburg in Berlin; 6, gives the analysis of the equestrian statue of the Kurfürst Johann Wilhelm in the market place at Düsseldorf; while 7 and 8 show the composition of two bronze statues in Paris, of Louis XIV. and Louis XV.

A. Analyses of Old Bronzes.

	1	2	3	4	5	6	7	8
Copper	86·38	80·91	88·70	92·07	68·42	81·76	83·65	88·06
Tin	1·94	7·55	2·58	1·04	0.94	10·90	15·99	11·76
Zinc	3·36	3·08	3·71	2·65	—	—	—	—
Lead	5·68	5·33	3·54	—	22·76	5·25	—	—
Antimony	1·61	0·44	0·10	—	0·67	—	—	—
Iron	0·67	1·34	1·07	3·64	4·69	0·15	traces	traces
Nickel	—	—	—	—	0·78	traces	0·63	traces
Cobalt	—	—	—	—	—	1·22	—	—
Sulphur	—	0·31	—	—	—	—	—	—
Arsenic	—	—	—	—	1.48	—	—	—
Phosphorus	—	—	—	—	—	—	0·05	0·03
Silicic Acid	0·10	0·16	0·09	0·04	—	—	—	—
Loss	0·26	0·79	0·21	0·56	0·26	0·72	—	0·15
	100·00	100·00	100·00	100·00	100·00	100·00	100·32	100·00

B. Analyses of Chinese and Japanese Bronzes, with Blackish Patina.

	1	2	3	4	5	6	7
Copper	82·72	82·90	81·30	83·09	72·09	72·32	71·46
Tin	4·36	2·64	3·27	3·23	5·52	7·27	6·02
Zinc	1·86	2·74	3.27	0·50	0·67	6·00	5·94
Lead	9·90	10·46	11·05	11·50	20·31	14·59	16·34
Iron	0 55	0·64	0·67	0·22	1·73	0·28	0·25
	99·39	99·38	99·56	98·54	100·32	100·46	100·01

C. Mixtures for Chinese and Japanese Bronze Mirrors.

	1	2	3	4	5	6	7	8	9
Copper	50.8	80	80	76.3	75.2	81.3	87.0	81.3	71.5
Tin	16.5	15	—	23.6	22.6	16.3	8.7	—	—
Zinc	30.5	—	—	—	—	—	—	—	—
Lead	2.2	5	10	13.1	—	—	—	—	—
Iyo-shirome	—	—	10	—	—	—	—	—	—
Tori-shirome	—	—	—	—	—	—	—	16.3	28.5
	100.0	100.0	100.0	113.0	97.8	97.6	95.7	97.6	100.0

D. Metal Mixtures of Kanaya Gorosaburo in Kiôto.

	Japanse Names of Bronzes.							
	Kô-dô.	Tô-dô. Sei-dô.	Kio-dô.	Kô-tô-dô. Kin-shi-dô.	Kuro-dô.	Sento-ku-dô-mo.	Kara-kane.	Sento-ku.
Copper	65	80	20	60	80	48	60	35
Tin	—	—	70	15	6	10	30	17
Zinc	35	—	10	25	—	32	—	48
Lead	—	20	—	—	14	—	—	—
Antimony	—	—	—	—	—	10	10	—
	100	100	100	100	100	100	100	100

E. Mixtures of German and French Bronze for Statues.

	1	2	3	4	5	6	7	8
Copper	86.6	87.79	87.44	84.55	89.15	71.74	91.40	82.45
Tin	6.6	8.20	3.20	0.14	1.76	2.37	1.70	4.10
Zinc	3.3	1.77	8.89	15.63	8.59	25.58	5.35	10.30
Lead	3.3	2.20	0.65	0.16	0.32	0.91	1.37	3.15
	99.8	99.96	100.18	100.48	99.82	100.60	99.82	100.00

8.—Ceramics.

Prefatory Remarks.—Classification of Clay-wares with special regard to the Japanese.—Historical Survey.—Beginnings and Accomplishments of the Industry of Japan till the Introduction of the Potter's Wheel.—Progress.—Influence of Cha-no-yu.—The Invention and Manufacture of Porcelain in China.—Introduction of the Manufacture in Japan.—Its centres, also of the Stone-ware Industry.—Arita, Nayeshirogawa, Kagoshima, Kiôto, Seto, Ôta, Hongo, Kaga.—Stone-ware.—Banko-yaki and Imbe-yaki.

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8. A. W. Franks: "Catalogue of a Collection of Oriental Porcelain and Pottery." London, 1876.
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10. Ninagawa Noritane: "Kwan-ko-dzu-setsu, or History and Description of Ceramic Art." Tôkio, 1876–77.
11. Capt. Brinkley: A History of Japanese Ceramics. The Chrysanthemum and the Phœnix." Vol. iii. No. 1–6. Yokohama, 1886.
12. La Céramique, par M. J. Bing, in the magnificent work of L. Gonse: "L'Art Japonais." Paris, 1883.
13. G. Audsley and James Bowes: "Ceramic Art of Japan." London, 1881.

Pottery industry derives its name, Ceramics, from a Greek word—a designation which is used on account of its brevity, as it embraces everything that is formed out of clay by the hands of men and baked, from the common bricks to the finest porcelain. The old Greeks and Romans knew of clay (κέραμος[1]) that when it was wet it would stick to the feet, and when dry to the tongue; also that it had a peculiar smell when breathed upon, which cannot be described and yet cannot be mistaken. They knew also its plastic character, and its resistance to the influence of water and

[1] κέραμος signified originally a drinking-horn, and then also the earthen vessel and the clay from which it was made.

fire, and utilized these exceedingly valuable qualities in the manufacture of their very durable brick and of many sorts of vessels, as do we also. The nature of potter's clay, its origin, and the manner of its transformation when burned, so far as they could not be apprehended at a glance, also the geological and chemical properties, were as hidden from them as from the Chinese and Japanese, although these nations brought ceramic industry to its highest perfection, and for a long time excelled all others in the variety of raw materials employed, of the products, and of their modes of ornamentation.

No other branch of industry is of older origin, and no other is better adapted in its gradual development, and in the manner of treating the raw material, to a people of intelligence, artistic sense, and progress, than Ceramics. Its products enable us to judge of the limited civilization of the Trojans, and to recognise and admire the developed artistic sense and love of beauty of the Greeks and Etruscans. Buried for thousands of years in ruins and dust, they still preserve their form and decoration, and have become, as they have been excavated in modern times, not only a rich field of antiquarian investigation, but also often the patterns most worthy to be imitated in our modern industry.

In face of the fact that the clay-ware industry of many countries and peoples reaches back into pre-historic times, that its productions were almost indispensable to human beings, we can scarcely imagine in our own minds the civilization in the time of our ancestors without them. And yet there was a time in Germany when the people lived in caves, and supported life by hunting reindeer, bears, and other quadrupeds; when, like the South Sea islanders at their first contact with Europeans, they were unacquainted with metals and clay-wares, and prepared their food on heated slate and sandstones, instead of in pots and pans.

But to return to the Ceramic Art of Japan. For its better comprehension I give in advance a survey of the products concerned. Following the precedent of Brogniart, the various kinds of pottery are usually divided into two large groups, and distinguished as soft and hard, corresponding to the Japanese designations, Tsuchi-yaki and Ishi-yaki, *i.e.* "Burned Earth" and "Burned Stone." The soft clay-wares are burned generally with a smaller degree of heat, as in the fire of a porcelain furnace they would fuse together or smelt. The material is opaque, shows an earthen fracture, is easily scratched with a knife, is porous, and generally permits the filtering through of liquids. The glazing which is used to prevent this, and at the same time as a foundation for further decoration, is either alkali- or lead-glaze. In both cases it unites with a part of the silicic acid of the ware, producing a thin transparent glaze, or it is a tin-glaze which lies pretty thick upon the surface and forms an opaque milk-white enamel.

All earthenwares, from brick to the finest Faience, belong to this large division. In most of the subdivisions, clays (Tsuchi) are used. In consequence of mineral impurities, these burn to a grey, yellow, red, brown, or black, so that the colour of the fracture contrasts sharply with that of the glazing. The less careful preparation of the clay mass, by means of selection and pulverizing, corresponds to the smaller value of such wares. This group embraces:

(*a*) Unglazed earthenware, Japanese Kawarake, brick or Renga-seki, and tiles, Kawara. The simplest and cheapest clay-wares of Japan are made of brick-red burned Kawarake; they consist of dishes for baking beans, of small flat plates on which rice and other food is offered to the Shintô gods, and of vessels for preparing certain medicines. Most of the tiles, at least those burned in a suburb of Tôkio, have a blackish grey colour.

(*b*) Terra-cotta and other antique dishes, having a thin glazing which is produced by incipient smelting on the surface. These products of the Greeks and Romans are distinguished from those of other nations by the careful pulverizing and preparation of the raw material, and by their fine forms and decorations. The largest earthen vessels of Mediterranean countries must be reckoned under this head; for example, the urn-shaped Tinajas of the Spaniards, which are used for keeping olive oil, and often hold one hundred Arobas of 25 liters each. In the Crimea and in Asia Minor, similar urns are used for wine, and in Japan the Tsubo formed in the same way are used as receptacles for closets. According to Thunberg, Swota on the bay of Shimabara furnishes very large urns, that are used instead of casks for the reception of fæcal matter.

(*c*) Common pottery with lead or salt glazing. A large part of the earthen dishes of Japan belong, like our own, to this class. The so-called Toyosuke-yaki of Nagoya also, which is beautifully ornamented with lacquer painting, is made of this kind of earthenware.

(*d*) Common enamelled Faïence and Majolica. This has a porous earthy fracture, of different colours from that of the opaque glazing or the thick coating of tin enamel, which forms a sharply defined white crust. Many of the common table dishes, having the appearance of porcelain, but opaque, the Delft ware with its blue cobalt decorations, so celebrated in the 17th century, and the enamelled Faïence of the Middle Ages, and Majolica belong to this class. Japan can point to but few wares which may be catalogued here. The grey, brown, and green plates and vases, with raised enamel decorations, manufactured in the province of Ise, and often designated with stone-ware as Banko-yaki, must be classed as Majolica wares.

(*e*) Delft-ware, half porcelain or fine Faïence, was for a long time called Henry II. It ranks between hard burned porcelain and porous, soft earthenware. Delft-ware is made of pure, carefully prepared paste, very much like porcelain, and, like it, receives a transparent glazing. The fragment is white or yellow, close, hard, opaque, and of earthy fracture. Faïence[1] in Japan, as with us, plays a large part in art pottery. The celebrated Satsuma wares, Awata-yaki, Awaji, Ôta crockery, and other kinds belong to this group of pottery. As they are not exposed to so great a heat as porcelain, they offer a wide field for artistic polychrome decoration.

The second large division of ceramic productions embraces the hard, compact clay-wares. In burning they are subjected to such great heat that the clay mass is thereby fused or *verfrittet*[2] without being smelted. In cooling it becomes so hard that it cannot be scratched with a knife, and has a clear sound. The fragments show a smooth, conchoidal fracture. The confused mass of small crystalline needles, which may be seen with a microscope on the glazed crack, or the embedding of such needles in the amorphous, glassy mass is so close, that the article, even without glazing, would be impervious to water. Porcelain, stone-ware, and jasper or Wedgewood-ware, belong to the dense, hard clay-ware.

Stone-ware (see note) is made of ordinary material, and with less care than porcelain. It is greyish white, often yellow, red, and brown, even to black in colour, dense, highly vitrified, hard and resonant and transparent only at the edges. The glaze is a genuine glass, and is usually produced in the furnace by allowing the steam of the salt to operate upon the hot earthenware, whereby the muriatic acid thus engendered escapes. Germany was especially distinguished among European countries in the 16th century for its stone-ware or flint-ware industry. The towns of Höhr and Grenzhausen in the "Kannenbäckerland," near Montabaur, still carry on the industry extensively. Mineral-water jugs and drainage pipes also belong to flint-ware. In England it includes the celebrated Wedgewood-ware, especially jasper and Egyptian black or basalt-ware, likewise the larger part of the so-called jasper or red porcelain which Böttger manufactured at Meissen in 1707–1712, after Chinese patterns. In Japan, the Banko-yaki in Ise and the Imbe-yaki of Bizen are the chief pro-

[1] In many German collections and books we find a remarkable confusion of naming in regard to Faience, stone-ware, and flint-ware, though the chief Faïence manufacturers in Germany, such as Boch in Metlach, Guillaume in Bonn, and Wessel in Poppelsdorf, are clear enough in their distinctions. They call their goods "Steingut," knowing that there is no difference between it and fine Faïence, while the word "Steinzeug," or stone-ware, should be confined to the productions of the "Kannenbäckerland" (the pottery district of Höhr and Grenzhausen, near Coblenz), and similar hard-burnt crockery, which strike fire with steel. Steingut, or Delft-ware, has not been known in Japan longer than porcelain. But the origin of stone-ware is almost as ancient as that of ceramics in general.

[2] *Verfritten* is derived from the Italian *fritta* (roasted). *Fritte* means the mixture, *e.g.*, of the components of the glass in the preliminary smelting. Fritta colours. Fritta porcelain.

ductions of this class. Chinese jasper-ware and open-work flint-ware are said to come from the province of Shantung. The Moritz House in The Hague, and Leyden, have particularly fine specimens of it.

Porcelain stands at the head, as the noblest member of the numerous family of ceramics. To it belong all the dense, hard, transparent and resonant white clay-wares with or without glaze. Wherever glazing is employed, it is always transparent and very closely united with the porcelain, from which it differs only in its easier fusibility. The porcelain itself is usually made of the purest material and baked, after careful preparation, with a high degree of heat. In spite of the properties already mentioned, the definition of porcelain is much more difficult than might at first sight appear. For the differences in the elements and the composition by which it is conditioned, are so great, that on the one side, it approaches milk glass, on the other the stone-ware designated as mock-China, and the white flint-ware also so named. Unglazed porcelain is called biscuit or statue porcelain. The glazed porcelain is distinguished as hard and soft. The hard genuine stone porcelain cannot be scratched with a knife, has a clear sound, and sometimes shows sparks when struck with steel. Felspar or felspathic rock, together with kaolin is always used in its paste, which is burned in a very great heat (from 3000° to 4500° C.). Hard porcelain excels all other clay-wares in value for household use and that of the chemical laboratory, but it is not so good for decorative purposes as the soft porcelain and Delft-ware, offering many difficulties to polychromatic ornamentation.

The soft or fritted porcelain has a lead glazing, which may be scratched with the knife, produced by lead oxide with the addition of the flux. The paste which is prepared from Tertiary clay and Kaolin[1] flint receives an addition of plaster of Paris, or bone ashes for a flux. Soft porcelain, whether it resembles Delft-ware like the English, or, like French porcelain, more nearly approaches glass in its constituents and properties, melts at the temperature required for baking the common hard variety. The latter is therefore chiefly manufactured and used, and is always meant when porcelain is spoken of without distinction. We shall learn, however, that it has many grades, and that the Japanese particularly exhibits many peculiarities, as will be seen from a description of its manufacture. For a better understanding of the subject some historical facts will now be given.

The Japanese, like other nations, began in pre-historic times to form earthenware with but inferior tools and material, and only gradually reached a higher degree of artistic ability. When and where common earth was formed by the hand into coarse pots and other vessels, and burned like bricks by inappropriate method

[1] For the beautiful Seger-porcelain of modern times, no Kaolin is used, but Mikroklin from Ytterby, and fat, brown-coal clay.

of firing, can scarcely be ascertained, and is indifferent to our purposes. The chief sources of information are the discoveries in old tombs and other excavations. They show that the pottery of Japan, during the third century, and before the Corean immigration,[1] was still in swaddling clothes, and centuries later had not distinguished itself above the accomplishments of many other nations, until the introduction of the potter's wheel. The coarse, round forms with rough surface and without decoration, corresponded to the common material and its careless preparation. They were brick red, brown and black, unglazed terra-cottas, whose colour was often different on one side from that of the other, owing to an unequal degree of heat to which they had been exposed.

Brick roof tiles were burnt as early as 660 A.D. Flint-ware seems also to have been early discovered by accident. Pieces of this with a salt glazing are sometimes found.[2] But all of these probably originated after the introduction of the Rokuro or potter's wheel. This happened in 724 A.D., and is attributed to the celebrated Buddhist priest Giôgi (670–749 A.D.), with whose name several of the oldest monuments of art in the temples and cloisters at Nara are connected. That he must have exercised a great influence on the clay-ware industry of his country may be seen in the fact that its older products have the collective name, Giôgi-yaki.

Among the treasures of the pagoda Tôdaiji at Nara, there is a collection of black, hard, earthen articles, principally pots and vases, which apparently were made in the time of Giôgi, and show distinct traces of the potter's wheel. One of the most interesting antique pieces, indicating even at this time great skill in using this important apparatus, is a vase, which was found in a tomb at Hano, in Kôtsuke, together with valuable stones, bronze and iron. Plate XXXIII. at the beginning of the before-mentioned works of Ninegawa, gives a beautiful illustration of it. It is hard burned, of a blackish blue colour on the outside, and reddish in the fracture. Its form resembles that of the glass chalices known as "Roman," if we conceive of a cover above its vault, completing its spherical shape. This cover is formed toward the top into a rather wide cylindrical throat. The proportions are well chosen and the disposition of the simple curved and line ornamentation shows a fine taste.

The introduction of a glassy transparent glaze contributed in the 8th century to the progress already obtained through the potter's wheel. The salt glazing on stone-ware was evidently the oldest employed, as it has been also in our German pottery, and

[1] This began with the conquest of a part of Corea by Jingu Kôgô, in 202 A.D. (See vol. i. p. 217).

[2] The Ethnographical Museum at Berlin possesses a piece said to come from Awa, the gift of Dr. Hilgendorf. It is a cylinder standing on broad feet with three window-like openings in its walls.

especially in baking stone-ware for household purposes, has been used for many centuries. Coloured opaque glazing was introduced gradually, but the white tin enamel has never become really domesticated, not even in Cloisonné ware. In the centuries following, the introduction and general adoption of tea and the so-called Cha-no-yu, or ceremonial tea parties (in which ladies, however, took no part), proved a peculiar stimulus to the manufacture of pottery. Tea-pots, tea-cups, and urn-like covered vases for preserving tea, were much in demand. But the taste of the time had a peculiar tendency, as the coarse hand-made vessels were preferred if they could only show the black glazing, which was especially valued for the preservation of the tea. These properties were found notably in the kind of pottery known by the name of Raku-yaki. This was brought to Kiôto about 1570, by a Corean named Amenya, and called at first Juraku-yaki, after a quarter of the city in which the furnace was located. But after it had met with the approval of the mighty Taikô-sama (Hideyoshi), who distinguished its maker by bestowing on him a golden seal, bearing the inscription Raku, "delight," this word became universal as the designation of these wares.

The fancy for Raku-yaki and similar vessels for the preservation and preparation of tea, as well as the high price which was paid for such black jars in the second half of the 16th century, is mentioned by several authors of that time, Jan Huygen van Linschoten [1] and Antonio de Morga,[2] among others. Page 287 of the English edition of Morga has this paragraph :—

"In this island of Luzon . . . there are to be found amongst the natives some large jars of very ancient earthenware, of a dark colour, and not very sightly. . . . The Japanese seek for them and value them because they have found out that the root of a herb which they call Cha (tea), which is drunk hot, as a great dainty and a medicine among the kings and lords of Japan, does not keep or last except in these jars."

It may indeed be doubted whether the peculiar tendency of taste which originated with the Cha-no-yu, was not more of a hindrance than a means of advancement, in ceramics. Toward the end of the 16th century, this art succeeded in gaining a new foundation, upon which it soon attained a freer and more powerful position. This was the introduction of porcelain industry from China, to which the expedition of the Hideyoshi to Corea, was the stimulating impulse (see vol. i. p. 266). Before we take up minutely the introduction and development of higher ceramic art in Japan, let us glance first at its products generally, and their origin in China.

[1] "The voyage of J. H. Van Linschoten to the East Indies." From the old English translation of 1598, by A. Burnell. London, Hakluyt Society, 1875.

[2] "The Philippine Islands, Moluccas, Siam, Cambodia, Japan and China, at the close of the 16th century, by A. de Morga." London, Hakluyt Society, 1868

A white-burning paste which is usually prepared from two kinds of substances finely mixed and pulverized, namely, kaolin[1] (porcelain or pipeclay), and some other mineral rich in silicic acid, the so-called flux—usually felspar or pegmatite, porcelain stone,[2] or some other white-burning form of quartz, is used in the finer ceramics. Kaolin is distinguished by its plastic character and fireproof quality; the other constituent of the paste is called flux because it is fusible, and melts in the heat of the porcelain furnace to a glassy mass.

The relative proportions of the two ingredients of the paste, and the degree of heat to which the articles must be subjected in burning, depends on whether they are to have an earthy or glassy fracture, and whether they are to be opaque or transparent, and consequently whether they will be called porcelain or Faïence.

Kaolin is formed by the decomposition of felspar and kindred minerals. It is found as a product of the disintegration of felspar rock, especially of granite, porphyry and gneiss, always *in situ*, and frequently so mingled with the solid quartz of these rocks, that one can follow all the steps of the disintegration. Common potter's clay, however, for example the fatty, brown-coal clay (and also the loam of our fields) is a sediment formation, which is produced by water carrying off the original products of the decomposition of the rocks rich in alumina, and finally depositing them in layers, so that their origin is no longer recognisable.

Porcelain, like glass, is really a bi-silicate of alumina with alkali. But while in glass the proportion of silicic acid is at least 95 per cent., it varies in porcelain between 58 and 82 per cent. The proportion of alumina varies between 9 and 38 per cent. The amount of the alkali, in which potash usually predominates largely, amounts only exceptionally to 5 or 6 per cent. The lime present is seldom more than a fraction of one per cent. A higher per centage of silicic acid in the porcelain paste diminishes its plastic character (makes it dry), but renders the baking process easier, and furnishes a fine translucent porcelain more like glass, though not so hard. On the other hand, the quantity of alumina increases the plasticity, hardness and infusible quality. The paste, which is rich in alumina, however, requires more heat in baking, and furnishes a porcelain less transparent and more difficult to be treated by the decorator.

[1] The name comes from Kao-ling, *i.e.* "high back." This is the name of a hill, east of the Chinese porcelain city, King-te-chin, which hill, however, does not yield the product of decomposition which we in Europe call kaolin, but a phyllite, whose chemical composition resembles that of the Swedish *Hälle-flinta* (?). It approaches that of the Japanese porcelain stone and of pegmatite, as is shown by a collection of analyses at the close of this chapter.

[2] We shall see further on that these porcelain stones, which are wanting in our pottery industry, contribute greatly to that of China and Japan.

G. Wagener[1] classifies the common or hard porcelain according to the amount and relation of silicic acid contained, as follows:

a. Clay porcelain, like that of Meissen and Sèvres. It contains 30 to 36 per cent. of alumina, and may be considered as a mixture of infusible bi-silicate of alumina (Al_2O_3, $2\,SiO_2$) with glass free from argillaceous material.

b. Flint porcelain. This contains a surplus of silicic acid, and can be baked in a lower temperature than the two other groups. It approaches glass porcelain most nearly. By far the greatest amount of the porcelain brought to the market belongs to this class, especially the Chinese, Japanese, and Bohemian.

c. Silicate porcelain, a group formed chiefly of the porcelain product of Berlin, which, as is well known, requires a high degree of heat for baking, and excels all others in hardness and fireproof quality. Under the microscope, it appears as a glass-like, amorphous, homogeneous mass, corresponding to the qualities above named, and likewise in its chemical composition, consisting as it does of over 70 per cent. of tri-silicate of alumina (Al_2O_3, $3SiO_2$) with about 24 per cent. of glass free from clay.

It is well known that the Chinese invented porcelain. Six hundred years ago they manufactured many kinds of vessels from it, and decorated some of them with beautiful colours, which we are not yet able to imitate. Whoever wishes to see and study their great accomplishments, even at a time when the most of our clay-ware was still very rough and coarse, needs only to examine the fine Royal collection at Dresden. It has been arranged chronologically as far as possible, but the question as to the time of the manufacture of the first porcelain is as little answered there as elsewhere. Much has been written and argued concerning it, but still opinions are as divergent to-day as ever. This much is agreed upon, however, that the invention is not to be referred to a period before the Christian era.

In the district of Jaotscheu, province of Kiang-si, east of Lake Poyang, is situated the celebrated King-te-tschin, which supplies all China with porcelain. It is said to have employed in former times over 3,000 furnaces for burning porcelain, and a million of workmen.

The Tai-ping Rebellion, which dealt such a heavy blow to Chinese art industry some thirty years ago, from which it has not yet fully recovered, destroyed also the furnaces of King-te-tschin, together with the closely connected flourishing industry of the inhabitants. Although much has been done since then to revive it, it has not yet attained its former capabilities.

King-te-tschin is situated about 54 kilometers north-east of the capital Jaotscheu, and was named about 1004 A.D., after an emperor of the Sung dynasty, who established the first porcelain

[1] "Ueber Glas, Glasuren, Porzellan, Steinzeuge und feuerfeste Thone," by Dr. G. Wagener in Tôkio, *Dingl. Pol. Journal*, Bd. 246 (1882), p. 33.

furnaces there. Burning establishments for earthenware, however, had been in existence there since 583 A.D., according to Salvétat, as the necessary raw material was found in the neighbourhood. St. Julien states that porcelain was manufactured much earlier, and places its invention between 185 B.C. and 83 A.D. It has been objected to this, with justice, that the Chinese statements on which he bases his theory, are like those of Marco Polo,[1] very superficial and indefinite, and most probably relate to quite other clay-wares.

The conception of porcelain[2] in Europe also, as late as the 17th century, was oftentimes a false one, as the Netherlanders often called their opaque Faïence, porcelain, just as Böttger later made the same mistake with his red and brown stone-ware. Names signify little in this connection, but the meaning is everything. The Chinese at this time used the name Thao for their glazed opaque earthenware, says Sartel,[3] while the designation Yao, for porcelain, is said to appear first in the 9th century. It is to be presumed, therefore, that the hard, shell-like white and transparent wares which we call porcelain, were first manufactured at the beginning of the 9th century. The first unequivocal mention of porcelain, made by the Arab Soleiman, who visited China about the middle of the 9th century, agrees with this opinion. W. Williams,[4] who is well acquainted with China, mentions prominently that King-te-tschin did not furnish a better sort of porcelain till after 1000 A.D. This was the time when the cobalt decorations under glaze were first employed, which from then till now have played such an important part in the ornamentation of Chinese porcelain, especially for domestic use among the Chinese themselves.

I must not omit to mention here, that the late Sir Harry Parkes, during his long residence in China and Japan, was always of the opinion that porcelain was not known till the twelfth or the beginning of the thirteenth century. The fact that Chinese porcelain was not known in Japan till the 13th century, harmonizes with this opinion. Captain Brinkley, in his work on the history of Japanese Ceramics, calls attention to this, pointing to the fact that Japan, from its earliest connection with China, either in direct communication, or by way of Corea, has prized and imported the manifold productions of Chinese art industry, and it seems doubly striking, therefore, that porcelain did not appear earlier, if existing at that time.

[1] "Histoire et Fabrication de la Porcelaine Chinoise," par S. Julien. Préface de M. Salvétat. Paris, 1856.

[2] The name porcelain was introduced by the Portuguese, who were the first to bring large quantities of Chinese products to Europe. It refers to the exterior appearance, resembling the shiny white of the Cypræa or porcelain shell (Port. *Porcellana*).

[3] O. du Sartel, "Zur Geschichte der chin. Keramik," in the catalogue of the Orientalische-Keramischen Ausstellung in Vienna, 1884.

[4] "The Middle Kingdom." Vol. ii. p. 23. London, 1883.

The beautiful coloured ground tints, chalcedony, dull violet, yellow, and Turkish blue, so much valued by collectors, began to be used in the 13th century. The most flourishing period of Chinese porcelain making, however, like that of most other branches of its art industry, was during the Ming dynasty, especially in the second half of the 15th century. During this period its manufacture occupied a new position, owing to the employment of many coloured decorations upon glaze. The so-called five principal Chinese colours were used for these, viz., green (east), red (south), white (west), black (north), and yellow (earth), to which the blue of heaven was added as a sixth. Gold, and gold-purple, were not used till the year 1690.

Single pieces of Chinese porcelain were introduced gradually into the countries of Southern and Western Asia, and even into Egypt, by the Arabs and Persians. Its distribution in Europe devolved on the Portuguese after the sea-passage to India was discovered, and later upon their successors in trade with Eastern Asia—the Dutch and English.

During the first half of the 18th century, as has been remarked on page 335, Chinese patterns were borrowed for the new direction in artistic pottery, not only at Meissen (Böttger), but also at Sèvres, Stoke-upon-Trent (Wedgewood), and elsewhere. The porcelain and pottery collection, founded by Augustus the Strong, king of Saxony, operated as a powerful and active stimulus to the works of Böttger and his associates, so that it is easy to point out how directly the old Meissen style was formed by it.

The languages of Japan and China have no word which distinguishes porcelain sharply and unequivocally from all other clay-wares; but there are enough other evidences that Japanese porcelain manufacture is not yet three hundred years old, and that its introduction is closely connected with the expedition of Hideyoshi to Corea in 1592–1598 A.D. Documents of this date, and the written and orally communicated history of porcelain and Faience manufacture in the several provinces, as well as its existing productions whose origin is well known, corroborate the belief that it began at this time with the forced importation of Corean potters by the Daimiôs of Satsuma, Hizen, Chôshiu, and several others, in their dominions, in 1598. The founding of artistic pottery by these Coreans in Arita, Naëshirogawa, Kagoshima, Hagi, and other places, was one of the most important consequence of this expedition for the conquest of Corea and China.[1]

As has been said before, Japanese clay-wares are not designated according to their character, but their origin. Awata-yaki, Kutani-yaki, Seto-mono, Banko-yaki, and numerous other names, show this. The designations Ishi-yaki for hard-burned

[1] Corea, which now appears so poor in comparison with China and Japan, and whose art industry has degenerated so much, once manufactured many articles of high artistic value, especially in porcelain and bronze.

resonant porcelain and stone-ware, and Tsuchi-yaki for softer earthenwares, however, are known and accepted everywhere. Porcelain decorated under glaze with cobalt is called Some-tsuke, and as it has been manufactured in quantities for household purposes for several centuries at Seto in Owari, Seto-mono has become the name not only for this special kind, but also for all blue decorated porcelain. This blue cobalt colour is the oldest in Japan as in China, and the most popular, as a glance in any porcelain shop will show. (Concerning its production at Seto, see p. 308.)

The finer ceramics of Japan present many very interesting features. The manufacture is not limited, as in China, to a single district, but has a number of centres, corresponding to the distribution of the valuable and various raw materials, each of which is distinguished by peculiarities of material and production. Moreover, while it is very meagrely furnished with apparatus and proper mechanical aids, its wonderful products show an astonishing development. It furnishes egg-shell porcelain of unexcelled fineness and purity, and oftentimes vases and flower-pots so large and strong, that the largest European specimens of the kind seem mere dwarfs in comparison. The manufacture of stone-ware is not so remarkable in its work.

It may be generally understood that the Japanese potter as a rule does not lay so much stress on the careful preparation and formation of the material as on the adornment of his wares. Quality, as has been said by M. Bing, is a matter of secondary importance.[1] He therefore employs not only the usual modes of decoration both over and under glaze, but has successfully brought lacquer painting and cell-enamelling to bear upon porcelain and crockery. In the polychromatic ornamentation of his wares, his great talents and sense of harmonious and pleasing colour-combinations are especially conspicuous ; they surpass those of other nations. In this respect, his former masters, the Chinese, fall far behind him. The Chinese have more brilliant and lively colours at their command in porcelain painting, but they do not often understand how to combine them effectively, and their efforts in ceramics, as in other departments, have declined, during the last few decades, with their taste for the fine arts. The Japanese, on the contrary, has not rested and rusted. The great amount of incitement and instruction which he has had during the last twenty years in the International Exhibitions and from educated foreigners in Japan, have not been lost upon him. His progress, which has been already noted in Metal Industry, is unmistakable in ceramics also. And in remarking upon this, it seems but fair also to mention the name of Dr. G. Wagener as one who, more than any other foreigner, has been able to promote art industry in Japan by his knowledge and practical advice. I found the traces of his

[1] In "L'Art Japonais," par L. Gonse, chap. ix. La Ceramique, vol. ii. p. 242.

beneficent and unselfish activity in the porcelain painting of Arita, in the metal and enamel work of Kiôto, in the cabinet-making of Tôkio, and elsewhere.

Compared with our European porcelain and stone-ware factories, those of the Japanese seem small, a business employing forty or fifty labourers being one of the largest. The lighter labours, such as rubbing the colours, glazing, etc., are often performed by women, while the working of the material, shaping, and burning, is always done by men. In order to form an idea of the extremely simple and primitive working apparatus, we must throw ourselves back a hundred years or more, into the time when in our own country porcelain was burned in low kilns, and the entire preparation of the material was effected without machines, or with only the help of the simplest possible water-power works. In Japan, too, the materials needed are not all usually found in the place of manufacture, and nowhere are they prepared and then brought to market, as in China, for instance, or as the "China clay" in England, but every factory provides them for itself, in raw condition, sometimes from great distances, and in the most inconvenient ways.

The constituents are separately broken up, washed, sifted, etc., before they are weighed, measured, and mixed together. In breaking up the hard porcelain stones, felspar, or quartz, the primitive stamping-mill is used universally, as in rice husking described on page 45. These automatic stamping-mills are found generally on the little water courses long before the factory is reached. Their slow work lasts for several days usually, before the small quantity of stone is broken up finely enough, in the iron-bound troughs, to be carried to the washing process. These old-fashioned stamp mills, with their slow movement, were formerly used very generally in Europe,—for example, in the mining districts of the Harz and Saxon Mountains.

They are still used in Asia Minor, Armenia, and Persia, to pulverize various substances, among them oak tan-bark, as was lately observed by the correspondent of the *Cologne Gazette* at Niksar.[1]

The washing of the pulverized material (porcelain stone, kaolin, felspar, quartz) is done by hand after the old fashion, in disconnected tubes, barrels, or mortar-beds, and stirred about in water with paddles, and then left to rest for a short time that the coarser and heavier particles may settle to the bottom. The separation of the fine floating paste is effected by opening one or the other of the tap-holes, of which there are usually four placed irregularly one above the other. Finally, the whole pulpy mass is passed through a fine cloth sieve, which separates all the coarse grains and other impurities.

Funnel-shaped boxes are used in place of our filter presses. The walls are made of staves. On the bottom is a layer of gravel

[1] "Ein Ausflug ins Armenische," *Köln. Zeitung*, 21/2, 1886.

or perfectly fine washed material with a straw mat laid over it. When the pasty substance is poured in, the water filters partly through, while the clay paste is deposited gradually. The water which collects upon it is drained off through a side opening, and the material is dried in a red-hot furnace and finally worked up and kneaded with the feet and hands. When this is done, it is

Fig. 19.—TEAPOT OF GREY-BROWN STONE-WARE: FROM KUWANA, IN ISE.

left to ferment in a pit or damp chest, not for a year, as was formerly the case in China, it is said, but for a few weeks or months, before using in the factory.

By far the largest part of the clay-wares of Japan are shaped on the Rokuro or potter's wheel. The apparatus employed for this purpose is mostly of the simplest form, the shaping board serving at the same time as the swinging-wheel. It has a hole near the edge in which a rod, 20 centimeters long, is placed, by which it is set in motion. In a more developed state, as at Arita, for instance, the larger wheel is bound firmly to the shaping board, some 20 to 30 centimeters apart, by four rods, and is turned with the feet. Plaster of Paris moulds and castings of the material are as uncommon as the employment of patterns and models. These are indeed striking wants, but the Japanese substitutes for them his great skill in the handling of his machine and of the remarkably plastic material. Articles having an elliptical or polygonal cross-section cannot of course be turned on the wheel, but are shaped in moulds of burnt clay or wood. In the latter case, the Kata or mould is separated into smaller parts. (See Banko-yaki.) The handle, cover and its knob, sieve and spout of teapots, etc., are each formed separately and fastened to the body of the vessel.

For example, the spout with its sieve on the inside, the foot, handle, cover, and chain, as well as the applied decoration (pâte sur pâte) of the pot of grey stone-ware, 16 centimeters high, from Kuwana in Ise (Fig. 19) were all shaped separately and then fitted to the pot itself. The handle and cover represent branches of the popular Matsu or pine, which divide and lie with their needles close upon the foundation. The bamboo decoration is also shaped by itself and pressed on, and the circle of Kiku-no-hana, or Chrysanthemum flowers at the base. All the figures are of the same material, a rough, lustreless biscuit on the outside, and transparently enamelled within.

Porcelain firing is done with pine-wood as fuel, and in the so-called low furnace, the Kama, like other clay-wares. A quick drying of the ware in the biscuit kiln goes before the hard burning of the porcelain. This furnace, a simple vault of moderate size, is almost always placed in the courtyard of the factory. The interior is divided lengthwise into a narrow passage for the fire, and a wider space for an oven, by a wall 60 centimeters high, made of upright, thick slabs of fire clay. The articles to be burned are generally placed in the oven without covering. There is an opening at one end of the fire passage for putting in wood, and a place is made for the draft at the sill and through a row of holes high at the back. When the fire is lighted, the flame mounts over the fire-proof partition wall away to the top of the arch, follows it up over the porcelain chamber, and then falls on the steeper side, and operates by its heat on the porcelain from above, the same as on the other side. The length of time necessary for burning the biscuit varies greatly, depending on the material, the construction of the furnace, etc., and can only be determined by experience.

After cooling the porcelain, comes painting under glaze with cobalt, and other decoration, then immersion in the glazing material, and drying, just as with us.

The glaze, Jap. Kusuri, is prepared from the argillaceous flux (felspar, pegmatite, porcelain stone) used in the factory, by careful sorting and working into a fine paste together wood ashes cleared from their lye. For porcelain, common Isu-bai, the ashes from the bark of *Distylium racemosum*, S. and Z. (see page 251) is used, following the example of Arita; for stone-ware, usually Nara-no-hai, oak-wood ashes from *Quercus glandulifera*, Bl., or Kuri-no-hai, from the wood of *Castanea vulgaris*, Lamk. (see page 244). Dr. Sarnow, to whom I gave a sample of Isu-bai which I had brought with me for analysis, found in it the following proportions: 38·27 parts lime, 3·90 magnesia, 0·66 manganous carbonate, 0·24 iron oxide, 8·23 potash, 10·65 silicic acid, 3·61 phosphoric acid, 1·27 sulphuric acid, 0·45 chlorine, 26·85 carbonic acid, 3·59 parts sand and 2·61 water. As the ashes of oak and chestnut woods are also rich in lime, it follows that the glazes used in Japan for porcelain and stone-ware form a transparent glass, rich in lime, whose composition varies, but is closely related to that of the material to be glazed, with which it must unite perfectly.

The porcelain furnaces used for the chief or second firing consist of a row of vaults of no regular number or size, but governed by requirements. There are usually, however, five to ten of them, placed behind and somewhat above each other on an inclined plane, so that the sill of each lies about 80 or 90 centimeters higher than the one before it. In large establishments, each vault is 2 Ken (3·64 meters) long, 3 Ken (5·46 meters) broad, and 8 Shaku (2·43 meters) high. The fire boxes are narrow passages, as in the biscuit kiln, near the boundary between the two arches, each of which has a special draft hole in the upper part of the arch, and on the same side with the opening where the fire is fed. The floor of the porcelain chamber is covered with sand, and in the final firing of the wares, part of them are placed in fire-proof cases, and part without, the article being placed only on a fire tile. When all is ready for the burning, the principal fire is lighted in the lowest arch and kept up from 6 to 12 hours. The other fires are now lighted gradually at intervals of one or two hours, so that really the firing lasts fully 24 hours, and then follows cooling, for which from 3 to 6 days must be allowed. The flames of the lowest fire circulate as in the biscuit furnace, the hot gases pass through the draft holes 80 to 90 centimeters high up on the wall, into the second arch at its floor, conformably to its higher position, and so on through the series of arches. When the fire in one arch goes out, the outward openings are all closed up. The necessary degree of heat for burning the wares is learned by practice; it must be so great in the upper arches, that a billet of wood held in one of the testing places is at once kindled.

A large well-constructed furnace of fire clay can be built for from about £15 to £20, and lasts twelve or fifteen years. It is covered with a light roof for protection from rain and violent winds. In the larger centres of industry, twelve and even twenty or more parallel furnaces are ranged at short distances along the same hill-sides, and not unfrequently one such furnace is used by several manufacturers alternately, like the bake-houses of German villages.

Although the loss in these low furnaces is not nearly so great as might be thought, the gallery furnaces of Europe, with their stages of fire-boxes and convenient arrangements for determining and regulating the heat, afford extraordinary advantages. That which is accomplished by the Chinese and Japanese by slow empirical processes, often the result of accident, is put to the test with us by the well directed aid of chemistry in the shortest possible time, as is the case in experiments with new materials and combinations, glazes and colours.

The colours used in Japan for decorating pottery are the same as with us, and are for the most part now imported from Europe. If some of them, however, *e.g.*, the blue of cobalt oxide and the red of iron, appear deeper, brighter, and more effective than with us, this is due in part to the different composition of the ground-work, the manner of applying them, and the heat of burning them in; but mainly to this fact, that they are longer, more carefully and finely ground, before using.

The most common vessels in Japanese ceramics are: Wan, cup; Cha-wan, tea dish, tea bowl; Temmoku, large cup; Choku, small, hemispherical cup for drinking Saké; Saké-dzuki, flat Saké dish; Domburi, large, hemispherical or cylindrical bowl; Hachi, bowl, porringer; Shiu-ro, brazier for warming the hands; Midzu-bachi, water basin for gold fish; Kôro, censer; Hana-ike, flower vase; Uye-ki-bachi, flower pot; Tokkuri, flask; Cha-bin, Cha-dashi, tea-pot; Kibisho and Kiusu, small teapot of porcelain or stone-ware, with straight hollow handle of the same material placed opposite the spout; Do-bin, an earthen teapot, with bamboo or rattan handle; Kuwashi-ire, sugar bowl, bonbonnière; Tsubo, egg or urn-shaped covered jar; Cha-tsubo or Cha-ire, tea caddy or covered jar for preserving tea; Kame, larger Tsubo; Tane-tsubo, jar for preserving seeds of different kinds; Shita-tsuki, saucer; Sara, plate, dish.

Artistic pottery also furnishes Oki-mono or knick-knacks of all sorts, birds, cocks and hens, and other animals, human figures, and, above all, hosts of Ningiô or dolls. One quarter of Kiôto, on the south side toward Fushimi, is especially notable for its large manufactories of dolls. For building purposes bricks have, during the last twenty years, been added to the long known and used tiles, owing to foreign influence. Their employment is constantly increasing, as brick houses are steadily replacing the combustible wooden buildings.

The chief manufactories of the finer Japanese ceramics, are at Arita, Kiôto, Seto, Kanazawa and Hongo for porcelain; Kagoshima, Kiôto and Ota for Faïence, and Yokkaichi for stone-ware. I

Ancient Vase of Arita Porcelain.

Wilhelm Engelmann, Leipzig.

visited all of them in 1874 and 1875, and studied their methods, the character and occurrence of the raw materials used, and other matters connected therewith, so far as time permitted, making memoranda which serve as basis for much that is written here. A map is attached to this work, illustrative of the chapter on Mining Industry, and giving nearly all the above places as well as the most notable deposits of various porcelain stones.

Arita Porcelain, Imari or Hizen.

All the porcelain which was brought into Europe previous to 1854 by the Dutch from Japan by way of Nagasaki, and which has been reckoned for a long time among the most valuable portion of ceramic collections, is known by one of the three above names, and also as "Old Hizen." The first of these names (formerly little used), denotes the place of manufacture; the second, the small neighbouring harbour and shipping port; the third, the province in which the two, together with Nagasaki, are situated.

Arita lies very nearly in the middle of the most divided province of Japan, 15 Ri (about 36 miles) north of Nagasaki, on the farther side of the bay of Ômura, and 11 Ri west of Saga in 33° 10′ N. latitude and 129° 50′ E. of Greenwich. It is a small city of 1,200 dwelling-houses, and 6,000 inhabitants, most of whom have supported themselves for nearly 300 years as is the case in neighbouring towns, by the flourishing porcelain industry. Though it is not the central point of Japanese porcelain manufacture, as it has been repeatedly asserted, its industry is at any rate the most highly developed and most conspicuous of all the potteries in Japan.

The small town is situated at an elevation of 90 meters above the sea, in a hilly region, covered mainly with pine forests. One of these ranges of hills lying to the eastward, furnishes Arita immense and inexhaustible quantities of porcelain stone of incomparable quality. It is a peculiar material, from which pottery of the most varying forms is made, from the light and finest egg-shell porcelain to the imposing vases of two meters height.[1] The volcanic origin of Arita-ishi (Arita stone) has been recognised unanimously by those who have examined it in the place where it is found, as von Richthofen, Wagener, Rein and Lyman, or from specimens, as by Gümbel, Pabst and vom Rath.[2]

[1] The original of the coloured heliotype of Plate XIX. is in the collection of Wagner & Co., 2, Dessauer Street, Berlin, and belongs, on account of its cylindrical form and peculiar decoration (coloured butterflies raised on a white ground), without doubt to the rare specimens of Arita-yaki.

[2] Differing from his former opinion that it belongs to the tertiary unstratified rock, a formation full of silicic acid like Rhyolithic tufa (*Zeitschrift der deutschen geol. Gesellschaft*, 32 Bd. § 255). F. von Richthofen, in his latest work ("Führer für Forschungsreisende," 1886, p. 9, 590), which has just come from the press, expresses himself as follows: "The large deposits at Imari in Japan are pro-

Lyman[1] agrees with me in considering it to be a product of the transformation of the old volcanic rock, which is found close by in an unchanged state as perlite breccia and trachyte. This is indicated by its unstratified occurrence, its appearance, and the chemical analysis. It is a compact rock, as hard as tiles, and having 2·5–2·7 specific gravity. Its colour is a greyish white or soft yellow, strikingly resembling trachyte or felsite clay-stone, according to Gümbel.[2] The chemical analysis also agrees in this (see Appendix, table A). The best kind is almost pure kaolin, while in other places the rock is conglomerate, and intersected by numerous small quartz veins, which, according to Mr. G. vom Rath's careful examination at my request, are filled partly with very small quartz crystals, and in other portions with crystals of iron pyrites, which under the microscope appear distinctly in the form of dice and pyritohedrons.

This porcelain stone is obtained in quarries, extending over a range of about 1,000 meters. There are three principal kinds; one, white and entirely kaolinized, which also possesses the earthy character of kaolin; a second, blue and rich in quartz; and a third, yellow, and containing iron. The quarrying is entirely unsystematic, the material being followed up as deeply and widely as may be, without any great clearing away of other valueless materials.

Eleven years ago, no one had any idea of the extensive character of the deposit, nor of its depth. Any citizen, by making a small payment to the town, can take away as much Arita-ishi as he needs, but is not allowed to send any into other porcelain manufacturing districts, nor to foreign countries. The water power of small streams is used for stamping the material, and long before reaching Arita, the preparations and arrangements for this work may be seen along the roads leading to the town.

The preparation of the paste is very much simplified, in comparison to that necessary in other porcelain factories, as the Arita stone, in its several stages of decomposition, furnishes in itself the materials for making it plastic and fusible. Mention has already been made of the fact that the potter's wheel is not here as in other places the simple form moved by the hand and rod, but much oftener a combination of two wheels, the thick lower one being turned with the foot. The axis of the wheel is not of steel, but a hard-wood pointed tenon fastened to the floor. Some of the factories are very large for Japan, and manufacture, besides common articles for domestic needs, a great many vases, some of them of

duced by the action of solfataras upon soft, clayey sandstone." The latter, however, appear in the immediate neighbourhood of the porcelain stone, with the same proportion of argillaceous earth, and little less silicic acid; but show no trace of a transformation into porcelain stone, or any other generic relation with it. I agree with him, however, in regard to the action of the solfataras. (See page 316).

[1] "Geological Survey of Japan. Reports of Progress." Tôkio, 1879, p. 122.

[2] *Dingl. Pol. Journal*, 227 Bd., p. 501.

great size. A pair which I saw, were six feet eleven inches high (1·995 m.), and were of faultless burning, richly decorated with cobalt blue under glaze, and valued at 500 yen or about £100. Such pieces are made up of several parts, which must be dried for four or five days in the air after being shaped. They are then taken to the wheel again, and placed on a dish-like hollowed mass of soft material, when their edges are so trimmed off, like wood, with a piece of sharpened sheet-iron twice bent at right angles, that the parts fit together exactly, or dove-tail, in box-fashion. They are then softened at these points by long submersion in water, and put together, closely uniting at the points of contact, by means of the plastic paste. In the burning, which follows, they are placed on plates of fire-proof tile, without cases.

Egg-shell porcelain, Usu-de-yaki, *i.e.* "thin burned," is now made principally at Mikawaji, a place 3 Ri from Arita. A workman in Arita, however, showed us the process. The best, most finely pulverized and purified material is used in its manufacture. The dishes and cups are turned quite thin on a sharpened wooden gauging-rod, and then left upon it several days to dry in the open air, when, like the pieces of vases, they are further turned on the wheel, though much more thoroughly, and then burned in cases.

I saw a dozen large porcelain furnaces in Arita. The low vaults are larger than any others I observed in Japan, each one consisting of 12 to 16 arches, about 25 feet deep (7·58 m.), 15 feet (4·55 m.) broad, and from 10 to 12 (3·03 to 3·64 m.) high, all arranged in rows one above the other on an inclined plane. They are built of fire-proof clay and mud, on a floor covered with quartz sand, with an opening from two-thirds of a meter to one meter broad, and the fire boxes and testing places on one long side of the row, while the other long side is entirely closed. Each partition wall has a row of square openings about 25 to 30 centimeters above the floor, allowing the hot air to pass through from one vault to the next higher. The lowest and principal fire is kept burning for almost a whole day and the side fires are kindled about six hours after the first has been lighted. C. Gümbel analysed the raw material and the beautiful white porcelain of Arita also, with the following result: 70·74 per cent. $Si\,O_2$, 21·75 per cent. $Al_2\,O_3$, 2·02 per cent. $Fe\,O_3$, 0·72 per cent. Ca O, 0·02 per cent. Mg O, 3·23 per cent. Ka O, and 2·43 per cent. $Na_2\,O$.

The manufacture at Arita is generally traced back to Gorodayu Shonsui, a potter of the province of Ise, who lived at the beginning of the 16th century. Moved by the beauty and value of Chinese porcelain, which began to reach Japan at this time, he undertook a journey to King-te-tschin by way of Foochow, and remained there for five years for the purpose of learning the trade. After his return, in the 10th year of Yeishô (1514), he settled in the then insignificant town of Arita and prepared from the materials he had brought from King-te-tschin a number of coarse porcelain wares, decorated under glaze with blue cobalt. When his stock of Chinese porcelain material was exhausted, however, and he found himself obliged to depend on domestic clay, he could make nothing but Faience, as did his successors up to the close of the century, with cobalt decoration under glaze.

Ceramics, however, received a new impulse here, and in many other parts of Japan, with the return of the army from Corea (1598 A.D.). Nabeshima Naoshige, the Daimiô of Hizen, and one of the commanders of the Japanese troops in Corea, brought back with him several Corean potters, who settled first in the bathing resort Ureshimo, but later in Arita. One of them, Ri-sampei by name, in 1599, discovered porcelain stone on the Idzumi-yama to the east of Arita, and at once inaugurated the porcelain manufacture of Japan. The use of Benigara (red oxide of iron) followed some years after that of cobalt decoration under glaze—some say it was introduced by the Dutch in Deshima—and two years later decoration on glaze was introduced by Higashidôri Tokuzayemon, a potter of Arita, after he had learned the process from the captain of a Chinese junk, at Nagasaki. This was a great step forward, for at this time the notable skill and artistic talent of the Japanese began to develop. The Dutch, as early as 1680, imported "Old Hizen" from Nagasaki. The rich collection at Dresden offers greater advantages than any other in Europe to one who wishes to study the condition of the porcelain industry in that period.

It is made up mainly of large, urn-shaped, covered jars, or Tsubo, called tea-urns, because they served originally for preserving tea; also of hemispherical dishes (Domburi), and round, flat plates, Jap. Sara. They are decorated with flowers (pæonies and chrysanthemums especially), small landscapes, human figures, in red and gold, with sometimes a little green, but the use of blue, violet, yellow, and black muffle colours belongs to a later period. This "Old Hizen," which preserved its essential character up to the close of the 18th century, is now much sought for. A few plates, 61 centimeters in diameter, with fine landscape decorations, were considered cheaply bought, even in Japan, some twelve years ago, at 25 yen (£5), and could scarcely be purchased in Europe, in view of the great risk of transportation, for less than four or five times this amount.

Porcelain still stands at the head of all the celebrated products (known as Meibutsu) of the province of Hizen. It is said to be made altogether in about thirty-six places, although Arita far excels all the rest, and furnishes now, as 200 years ago, the most highly-valued wares of all Japan. Its porcelain is perfectly uniform, and adds considerable translucence to a pure white colour, besides being hard enough for all the purposes of ordinary life. It burns so easily that decorative art has in its surface, as in that of Faïence, a fine field, and is aided also by the very plastic character of the excellent material.

a. Arita Porcelain Box.

b. Old Satsuma Stonewase Bowl.

Wilhelm Engelmann, Leipzig.

Its forms have greatly altered during the last few decades, owing to the influence of foreign customers, and have become better adapted to European tastes and uses. All kinds of plates, with tea and coffee services, are exported. The urn-shaped covered jars, without handles, have almost entirely disappeared from the number of larger decorative pieces, and open flower-vases of various forms and sizes have taken their place. The wavy and bent-edged vases without handles, which were never made in former times, are now especially numerous. I have already described some (page 377) which are decorated with lacquer-painting; these of course cannot be glazed. Boiled glue with iron ochre (Tonoko) ground to a paste forms the material of the ground-work in these cases. When it is dry, and smoothly polished, Naka-nuri, Togi, and Makiyeshi work follow, as has been described in detail under lacquer industry.

THE AMAKUSA-ISHI, OR STONE OF AMAKUSA.

A small group of islands, named Amakusa, after the largest and most western of the number, lies south of the province of Hizen and its volcanic peninsula Shimabara, in 32° to 32½° N. Latitude, and from 130° to 130⅓° E. of Greenwich.[1] The north-western part of the island of Amakusa can be reached from Nagasaki by the southerly road, which leads to the beautifully situated little port of Mogi, 2 ri distant, and then by a three hours' sail over the Chijiwa-nada, landing in Tomioka. Desirous of becoming acquainted with the places where porcelain stone is quarried, which I had seen designated as Amakusa-ishi in Ota near Yokohama, Kiôto, and elsewhere, I undertook this journey in the spring of 1875. This remarkable material is obtained at several places on the western coast, from 2 to 6 ri south-west from Tomioka, not far from the post stations Shimotsuke-Fukei, Kodakoro, and Takahama. It is used in the last-named place also for making a common porcelain, but is chiefly sent into other parts of the country. The best comes from the Iguchi-yama, 1 ri east of Takahama, in whose vicinity there is also an antimony mine (see page 309).

Porcelain stone appears on this sterile island, with its slate and sandstone rock, partly in great masses, standing often alone, but generally surrounded with yellowish or grey-white clay sandstone. It is a metamorphic, volcanic rock, white, grey-white or yellowish in colour, similar to Arita-ishi but firmer, harder and heavier, and is partly silicated and partly kaolinized. The body presents a fine-grained mass of kaolin and quartz, and contains single quartz grains as well as crystalline hollow spaces from

[1] The excellent map of B. Hassenstein, in his large Atlas of Japan, serves best for finding these places; but the maps belonging to the first volume of this work will also suffice.

which common felspar or plagioklas crystals have crumbled away. G. vom Rath found on the walls of these spaces and on small clefts and corners, infinitesimally small splinters of iron mica and apparently new-formed little quartz crystals. These little crystal-shaped cavities are seen in every specimen and are therefore the most striking marks for the recognition and distinction of the Amakusa stone. This rock contains a large proportion of potash, as may be seen in the analysis of C. Sarnow, I. Table B. A comparison of the chemical composition of other stones given there, shows that in this respect Amakusa-ishi stands next to the pegmatite (VIII.) of Yükan in China.

Amakusa belongs to the province of Higo, situated to the east, on the island of Kiushiu, where a clay-ware manufacture was established at Yatsushiro, after the Corean expedition, which is more notable for the peculiar treatment and ornamentation of its productions than for their extent and high character. Kato Kiyomasa,[1] the great antagonist of Konishi Yukinaga and bitter enemy of the Christians (see vol. i. p. 284), is said to have brought about their introduction through the Corean Kizo. It is a kind of stone-ware or hard porcelain, of a grey or greyish brown colour, in which the decorations are of inlaying or incrustations of white porcelain material, similar to that of Banko-Yaki. (See Plate XXIII., figure 2, on the right at the top of the page).

Satsuma Faïence of Kagoshima and Nayeshirogawa.

The province of Satsuma, which bounds Higo on the south, is known to collectors as furnishing the most beautiful and most valuable Faïence of Eastern Asia. Satsuma-Yaki, the designation given it in the country, is distinguished less by its composition than by its decoration. Whatever can be conceived by inventive genius, taste and perseverance, is here accomplished in form and decorations.[2] A glaze adapted to the ware, varying in its soft yellow colour from that of old ivory to cream, is the fitting groundwork of this ornamentation, that consists of fine hairlike cracks (*craquelé*) of the glaze, and in open work and relief decorations of the material

[1] A remarkable equestrian statue in bronze, representing this hero, may be seen in the Industrial Art Museum at Kensington.

[2] The heliotype (Plate XXI.) representing an urn of cream white Faïence of Kagoshima shows the character of the decoration of Satsuma-Yaki in one of its most original forms, which Japan has borrowed from China, and often employs for censers, but in such case, in metal. The two winglike handles, with their grotesque decoration, are specially striking. The vessel rests on three feet and terminates at the top in a Botan blossom (*Pæonia Moutan*), forming a knob on the cover. It is painted with gold and muffle colours. The principal pattern of the ornaments, the leaves and blossoms of the chrysanthemum and patrinia (Kiku-no-hana and Omina-meshi, p. 274) are distinctly seen in the illustration.

PHOTOTYPE BY STRUMPER & CO., HAMBURG.

SATSUMA STONEWARE URN.

Original in the ROYAL KUNSTGEWERBE MUSEUM Berlin.

Sake Flask of Kaga-Porcelain.

Wilhelm Engelmann, Leipzig.

Banko-yaki from Yokkaichi.

Wilhelm Engelmann, Leipzig.

itself. This is often made to imitate basket ware. The ornamentation, however, consists in a rich, soft and harmonious tone of polychromatic painting. The formation of the hairlike cracks (in our artistic pottery the sign of a great miscalculation of the small amount of shrinkage after the biscuit burning and of a quick and very contractile glaze) is produced intentionally by the Chinese and Japanese, and when well done, is much admired. Satsuma crackleware and all its imitations, like Awata-yaki, Awaji-yaki, Ota-yaki, has a narrow meshed net of such fine cracks, while in the older Chinese crackle porcelain, the meshes and cracks are much wider and coarser.

The Japanese call this crackled clay-ware Hibi-yaki or Hibi-de. They employ in its manufacture a glaze of felspar with leached wood ashes, which assimilate with the glazing material, making it more easily fusible. The decorations in gold, red and green, represent flowers, principally chrysanthemums, pæonies, maples; fowls, peacocks and other birds are also subjects most frequently taken. Censers, tea-pots, bowls and dishes, and in later times, vases, urns and other larger articles, are the main productions of this industry.

Its introduction is connected with the expedition to Corea. Shimadzu Yoshihisa, Daimiô of Satsuma, on his return to his own country in 1598, brought with him a large number of Corean potters and their families, gave them the rank of Samurai, and settled them in Kagoshima and several other places. Five years later he gathered the most of them (seventeen families) in the "Corean village," Nayeshirogawa, 6 ri distant. Their descendants live there still and continue the manufacture of pottery. They have adopted the Japanese dress, mode of living and language, but hold themselves otherwise aloof, and corporately preserve their Corean character. They are a stronger type of men than the Japanese, with intelligent features, very prominent cheek-bones and pointed chin, resembling in this respect more the inhabitants of Riukiu.

The first generation manufactured only Raku-yaki, a black glazed ware having no artistic quality and which had already been made in Kiôto by other Coreans under Hideyoshi. Tea-pots, bowls and cups, and a quantity of other earthenware of this kind, are still manufactured. Others produced crackle stone-ware, as in the factory at Kagoshima; still others genuine porcelain of Amakusaishi, and domestic kaolin, using Isu-bai as a glaze. The products, however, are designed exclusively for the domestic market, and none of them are in any way remarkable.

The products which come to the European market under the names Satsuma, Satsuma Faïence, Satsuma ware, are not from the Corean village, but were formerly manufactured in Tatsuno, near Kagoshima. About twenty years ago the factory passed into the hands of a company of Samurai, the Tôki-gaisha, which established itself at Tano-ura, beautifully situated about 2 miles from the capital city Kagoshima on the bay.

The white porcelain stone Kaseda or Kaseda-ishi was discovered between 1624 and 1644 A.D., and took its name from the place of discovery in the neighbourhood of the little town of Kaseda, south-west of Kagoshima. An analysis of this material, with which I am not further acquainted, is given in Table B, IV. The discovery of the kaolin of Ibusuki[1] occurred also at this time. The art of polychromatic painting was introduced at the close of the 18th century by two Coreans who had learned it in Kiôto.

At present the material is prepared in Tano-ura of 13 parts Kaseda, 18 parts Ibusuki and 3 parts of Kirishima-tsuchi, the glaze of 10 parts of white Kaseda (Shira-ishi) and 5 parts of Nara-bai, *i.e.* oak-wood ashes.

Imitations of the fine Faïence of Satsuma, more or less successful, have been made for many years in several Japanese towns, and are exported to foreign countries in large quantities and at low prices, some under the name of Satsuma and some by the rightful designation Awata-yaki, Awai-yaki, Ôta-yaki. The durability of the most of them is much less, and the colouring in many cases somewhat different, now more yellow as in Awata-yaki, and again changing in tint to grey or white. It needs, however, a practised eye to distinguish many of these products from genuine Satsuma ware.

The Pottery in Kiôto.

As the silk and metal industry is concentrated on the right side of the Kamo-gawa, in the principal part of the old Japanese capital, the ceramic manufacture has established itself upon the left side, in the eastern part of the city. It furnishes, besides ordinary pottery, Faïence and porcelain in large quantities and excellent quality. The beginning of this industry dates back to the middle of the 17th century.

Ninsei, an amateur potter of the family Nonomura, which was numbered with the Fujiwara, gave a new impulse and higher aim to the manufacture of pottery in Kiôto in the second half of the above-named century, by the introduction of transparent glaze into several factories in the suburbs, and by the manufacture of a kind of Faïence and half-porcelain. The productions, Ninsei-yaki, created by his art from Shigaraki and other clays of the vicinity,

[1] Ibusuki is made out of a mixture of three kinds of kaolin, viz: 10 parts Neba, 3 parts Bara, and 5 parts Matsuyakubo. Nara-bai, the oak-wood ashes of the glaze, is analyzed by Atkinson as follows: 3·33 per cent. water, 8·405 per cent. silicic acid, 4·785 per cent. alumina, 3·300 per cent. iron oxide, 42·765 per cent. lime, 2·415 per cent. (?), potash 0·74 per cent., soda, 0·215 per cent. carbonic acid 34·145 per cent. The high percentage of carbonic acid and lime shows that Atkinson could not have had a pure specimen of wood ashes for examination, but one mixed with carbonate of lime.

are distinguished not only by a more careful treatment of the material, but especially by their beautiful and boldly designed decorations, and now-a-days are much sought after. The same is true of the Kenzan-yaki, which was made by his most celebrated pupil in the first half of the 18th century. It has a yellowish colour (Ki-iro). The manufacturer, Ogata Shinsei, was called Shisui Kenzan (*i.e.* beautiful blue north-west mountain), after the factory located in the north-western part of Kiôto, at the foot of the Atago-yama (Ken-zan). The present Faïence industry in the suburb Awata has been developed from the Kenzan-yaki and Ninsei-yaki, and also the porcelain manufacture at Kiyomidzu.

Awata-yaki is manufactured in the eastern part of Kiôto, on both sides of the road which leads to Ôtsu in Ômi. For the material of this kind of crockery three or four kinds of kaolin or clays, viz. Shigaraki-tsuchi [1] and Kagami-yama-tsuchi from Ômi, Okazaki-tsuchi and Dainichi-yama-tsuchi from the vicinity of Kiôto, are mixed in equal parts after previous preparation. It burns to a grey white with a touch of red in the first fire (biscuit burning), but appears almost white after the principal burning. The yellowish crackle glaze is said to be obtained by mixing equal parts of Seki (stone, probably Amakusa-ishi) and Aku, the ashes from the waste of the indigo plant (see p. 177).[2]

The porcelain industry of Kiôto has its seat in the Kiyomidzu quarter, at the foot of the Higashi-yama, south of Awata (see vol. i. map of Kiôto). In Gojô-dôri or Gojô-saka, the street leading from the temple Kiyomidzu to the Kamo-gawa is a continuous row of porcelain shops. Many sell the wares manufactured by themselves. The predominance of the blue cobalt decoration is already recognised from a distance, and shows that the industry serves Japanese households principally; nevertheless, in modern times, the most important houses, such as Dô-hachi and Rôku-bai, have adapted themselves likewise to the tastes of foreign customers. This is even more true of Ken-zan, whose factory is situated between Gojô-zaka and Yasaka. Many of the most beautiful pieces of Kiyomidzu-yaki which are seen in the Industrial Art Museum in Berlin are of his manufacture; they are distinguished by their great hardness, purity, transparency, and a beautiful white colour, which sets off the cobalt blue particularly well. The material of these valuable wares is made of 7 parts Amakusa-ishi and 3 parts Shigaraki-tsuchi; the glaze of Amakusa-ishi and Isu-bai.

Awaji-yaki or Mimpei-yaki. At the Universal Exhibition in Vienna, a sort of Faïence by this name, similar to the Awata-yaki, attracted much attention on account of its fine crackled glaze and extraordinarily careful and delicate painting. It originated in the

[1] An analysis of this kaolin may be found in Table C, No. I.

[2] The ware is called Tamago-yaki (egg-burned), probably on account of this yellowish colour.

town of Igano-mura, on the island of Awaji in Idzumi-nada (Bay of Ôsaka), from a small factory erected in 1838 by Kashiu Mimpei, whose son Sanpei now carries on the manufacture.

The pottery industry of Owari, Mino, and Mikawa embraces the border territory of these three provinces, and has developed itself mostly at Seto, in north-eastern Owari, 5 ri from the capital city Nagoya, so that this, like Arita in Hizen, may be considered in age and the influence of its industry as the central point of this second important pottery district of Japan. It is a hilly country, extending to the passage of the Nakasendô from Shinano to Mino, and to the boundary of Owari and Mikawa toward the sea over the Tôkai-dô. The decomposition products of granite and slate mountains, principally quartzitic rubble, and white or mud-coloured bald spots of clay, and a meagre vegetation of pine and bush forest, cover the long extended, low range of hills, scarcely 200 meters high. Only here and there are seen granite rocks and old slate of blackish grey colour, which appear much oftener on the larger stretches, and less soft as one draws near to the higher ridges on the frontier. On the other hand, fossiliferous Neo-tertiary strata are seen along the sides of these hills.

Every stage of transition may be seen, from the well-preserved granite, 7 miles and a half from Seto onwards, to the decomposition, kaolinising, and further transformation of felspar into many clay deposits which appear on the hill slopes and in the valleys, or are covered with boulders. Granite and kaolin, richly sprinkled with quartz grains, form the principal groundwork of the ceramics of this district. In Owari the industry is concentrated around Seto, the manufacture having been carried on here for five hundred years. Among its manifold products are various small household articles, such as dishes and bowls for Saké, tea and rice, teapots, Saké bottles, small flower-vases and flower-pots of milk-white porcelain, tastefully decorated with blue cobalt painting both under and upon glaze. Fine large flower-pots are among the largest and most beautiful articles which Seto furnishes. The Royal Industrial Art Museum in Berlin has one of these. On the outside a grape vine, with leaves and clusters, is raised in white bas-relief on a deep blue ground, a piece of decoration of fine effect. Seto-mono, as this beautiful ware is called, is well known throughout the whole of Japan; indeed, the expression is often used as a generic name for all porcelain decorated in this way, signifying the same as Some-tsuke. Fine Seto-mono and Kiyomidzu-yaki approach each other so nearly that it is almost impossible to distinguish between them.[1] Seto porcelain is of a more glassy nature than Arita ware, is also less tough, and more easily broken. The porcelain biscuit is prepared in Seto of 10 parts Kairome-tsuchi, 8 parts Hon-ishi, 2 parts Chikura-ishi, and 2 parts Giyaman-ishi, the glaze of Hon-ishi, Giyaman-ishi, and

[1] The analyses of their materials may be compared in Table D, III. and IV.

Isu-bai. The names Kairome-tsuchi and Seto-tsuchi signify the kaolin of the vicinity, a greyish white, granulated material, in which the felspar of the granite is perfectly decomposed, but the numerous bright quartz grains appear in their original state, and are held together by kaolin. Hon-ishi or Chô-seki, *i.e.* chief stone, is the grey-white felspar of granite. It is obtained on the boundary of Owari and Mino, three hours distant from Seto, and pulverized at Akadzu, an hour's distance from Seto, by three days' stamping with water power in the manner before described, then washed and brought to Seto. The Chikura-ishi and Hiromi-ishi, the latter from Mikawa, seem to be very similar. Dr. Sarnow analysed a sample of Hon-ishi which I gave him, and found its contents as follows: 65·78 per cent. silicic acid, 20·22 per cent. alumina, 0·43 per cent. iron oxide, 0·77 per cent. lime, 10·33 per cent. potash, 1·24 per cent. soda, and 0·51 per cent. water, so that it approaches very nearly to the Swedish and Norwegian felspar (Mikroline), so much used in our German porcelain factories. It is easily smelted to a transparent, colourless glass.

Giyaman-ishi, *i.e.* glass-stone, is the name given to light grey or blue-white quartz, which is found in the vicinity of Seto, and is used in the Seto paste as a flux. The principal item to be observed in the composition of this paste is that it is made in the European manner, and resembles very closely the Bohemian porcelain paste.

Seto porcelain is burned partly in cases, but generally entirely uncovered, resting on fire-proof supports. In order to prevent the porcelain fastening to this stand by fusing, there is used a thin plate of grey talc, which is called Yori-tsuchi in Seto, and which must be pulverized and washed before shaping.

There are from 700 to 1,000 labourers employed in the porcelain industry of Seto itself. Owari furnishes much earthenware, besides Seto-mono, as for instance the Tokoname-yaki in Chidagori, 10 ri from Nagoya, the Inu-yama-yaki in Nuira-gori, and the Toyoske-yaki in Nagoya itself, which the Toyoske family finishes on the inside with coloured lead glaze, but on the outside with lacquer painting.

The foundation of the pottery industry in Owari is attributed to Kato-Shirosayemon, called Tôshiro, who, after spending five years in China to learn pottery work, returned in 1223, and settled down to its manufacture in Seto. He furnished glazed stone-ware, and, like Gorodayu Shonsui in Arita, used for his first efforts clay which he brought with him from China. Later he followed a common custom and changed his name again into Shunkei, so that Shunkei-yaki followed Tôshiro-yaki. Several of his successors distinguished themselves in the manufacture of tea-jars (Tsubo), and several other articles, which were highly prized during the time that the Cha-no-yu (tea parties) flourished. An inferior Faïence, with coloured enamel, was soon added to stone-ware, but the art of manufacturing porcelain was not learnt or practised till later, when a younger member of the Tôshiro family of potters, Kato-Tamikachi by name, discovered by stratagem the secret of the Arita potters.

Mino-yaki. The Mino wares, made up almost entirely of small useful articles, like teapots, plates, dishes, and rice-bowls, Saké-flasks, etc., are generally not so finely decorated as those of Seto, and are more adapted to the means and needs of the common people. Many sorts of earthen dishes are found among them; some of such excellent material and careful workmanship, that they might serve as a pattern for many of our common potters. The porcelain industry followed that of Seto, and was not introduced until 1810. It extends as far northward as the village of Nakatsugawa on the Nakasendô. It is carried on in a number of villages near to Owari, especially in Takayama, Tajimi, and Ichinokura. The most beautiful workmanship is to be found in small tea and Saké dishes of the finest porcelain, whose thin walls are produced by turning the air-dried form on the wheel, as in Hizen, and decorated, either in the above-named places or in Tôkio, with muffle colours.

Ôta-yaki, Makudzu-yaki.

In 1872 a merchant, Suzuki of Yokohama, established a factory in the neighbouring town of Ôta, with the intention to manufacture Satsuma and other Faïence, as well as porcelain, and especially to meet the demand of the foreign market for decorative pieces. He secured a potter by the name of Miyakawa Kôzan, from Kiôto, as director. Vases were manufactured principally, and Amakusa-ishi and several clays from the neighbouring Musashi were used as raw materials. Later, the business is said to have passed to Miyakawa, and the products have often been designated after his former residence, Makudzu-ga-hara, in Kiôto. Miyakawa displayed an uncommon activity, and was inexhaustible in the invention and employment of new designs of decoration, especially in high relief. His productions, which during the last fifteen years have been exported in large quantities and attracted much attention at the great International Industrial Exhibitions, betray many departures from good taste, together with some very original and beautiful designs. There were, for instance, at the Paris Exhibition large vases of long, cigar shape, with a striped glaze having the colouring of the Awata-yaki, around which large rusty anchors were represented in high relief, and on them little goblins sitting. There were other vases which were made with a lumpy or knobby surface in the lower part, resembling that of a wall which has been plastered with pasty cement mixed with little gravel stones. Open-work basket and bamboo weaving was also imitated with great exactness. All this impressed the judges in such a manner, that they added to the distinctions already received in Vienna and Philadelphia, the gold medal, as a recognition of the work of the exhibitor.

The Faïence of Ôta resembles porcelain very closely, and excels all other Japanese Delft-ware in hardness and firmness. Its colouring is somewhat between that of Satsuma and Awata-yaki; the factory, however, has produced no articles which are distinguished by polychromatic painting or which eclipse the better products of Kagoshima and Awata.

Hongo-yaki.

The town of Hongo, which gives its name to this porcelain, is situated in the Aidzu-taira (Plain of Aidzu), in the province of Iwashiro on the way from Sannô-tôge to the capital Wakamatsu, and about 5 miles distant from the latter. On the south side of the village rises a hill, on which at least a dozen low furnaces with their vaults following one upon another are ranged. Hard porcelain is manufactured here and decorated with cobalt colour under glaze; the ware, however, cannot compare favourably with that of Seto and Kiyomidzu in respect to fineness and decorative art. The industry is limited almost exclusively to common, useful articles. It uses neither felspar nor quartz, but finds a rich and valuable material in the volcanic, old crystalline products of decomposition at greater or less distance. Table B III. gives the composition of one of these materials, the Tonokuchi-ishi, which I saw in the neighbourhood of the Inawashiro Lake. The kaolins are found generally in the vicinity of Hongo. In one of the factories the material consists of 5 parts Shirojari, 3 parts Haguro, 3 parts Dobiyama-tsuchi, and 2 parts Tonokuchi. It has a tint of yellow, but burns to a pure white.

Kutani-yaki, or Kaga Porcelain.

Although it is not known exactly in what year (the date 1650 A.D. is commonly accepted) the manufacture of this peculiar porcelain, so highly prized on account of its decoration, began, its history is nevertheless much older than that of most of the porcelains which Japan has furnished. Mayeda Toshiharu, the first Daimiô of Daishôji in Kaga, soon after coming into power in 1639 A.D., brought a potter from Kiôto and commissioned him to seek for materials for fine clay-wares. The industry began after such materials had been found in Kutani-mura and elsewhere. The successor of the prince, Mayeda Toshiaki, in order to advance the work, sent a workman named Tamura Gonzayemon to Hizen, that he might learn there the manufacture of porcelain. After his return he erected the first porcelain furnace at Kutani-mura, 8 ri south-east of Daishôji, in the neighbourhood of the place where Kutani-ishi is found, of which we shall speak further on. According to another version, it was not Tamura Gonzayemon but a certain Gôtô Saijiro who founded this first porcelain factory at Kaga in 1650, aided by a very talented painter, who settled in Kaga, Kuzumi Morikage by name. His wares met with great approbation, not only with the prince of Kaga, but also with the Shôgun Tsunayoshi in Yeddo. Later the works of this factory declined in value, and toward the end of the 18th century the business was given up entirely. In June, 1810, the manufacture was again begun by a merchant in Kutani. As Kutani, however, lies high up in the mountains, and the long, severe winters hindered the workmen very much, the owner removed his factory in 1814 to the bathing-place Yamashiro-mura, 1 ri east of Daishôji. It was still in operation when I visited it in 1874, but two larger furnaces had been established since then, 8 chô (about a mile) outside of the place, which manufactured Kutani-yaki and common pottery with a kind of Faïence also. The porcelain is sent for the most part to Kanazawa, the capital of the province, and there decorated. The Kaga porcelain is made from a paste which consists of 8 parts of Kutani-ishi, 2 parts Nabetani-ishi, 6 parts Gokoji-tsuchi, and 4 parts of Yamashiro-tsuchi.[1] The last of these materials is a common potter's clay; the Gokoji-tsuchi is a kaolin, similar to that of Seto, sprinkled with many quartz grains. The Nabetani-ishi, more rightly Nabetani-tsuchi, of Nabeya-mura is found 8 ri from Yamashiro-mura on the way to Kanazawa, and is likewise a white-grained kaolin. Most interest centres on Kutani-ishi, an analysis of which is given in Table B II. This is a quartz porphyry, very much decomposed in its transformation into kaolin. It is greyish white when freshly broken, and reddish brown from the iron in its clefts and fissures. Small quartz crystals, isolated crystals of orthoclase, and little decomposed particles of biotite may be distinctly recognised in it and leave no doubt as to the character of the rock.

The preparation of the paste for Kutani-yaki is not so careful as with most other porcelain. Nor does it bake so white and smooth; the potsherd shows a much stronger inclination to red or grey and a granulated structure. If, nevertheless, the plates, vases, teapots, bowls, cups, etc. manufactured from it have a very high reputation throughout Japan, and range higher in price than the same articles made in other porcelain districts, it is due entirely to the peculiar rich and careful decoration with gold, gold purple and iron-red, to which in many cases sub-acetate of copper, but seldom a fifth colour, is added. This mode of decoration on glaze was introduced in 1814; before this, blue cobalt decoration under glaze was used, as in Seto and Kiôto porcelain. The most prominent works of Kaga porcelain painting in the last fifteen years are referable to a company of Samurai in Kanazawa, with Abé at the head. The decoration of the Kaga-yaki is so strikingly peculiar

[1] The glazing consists of 6 parts Kutani-ishi and 4 parts Isu-bai.

that, usually, it does not require much practice to recognise it. Generally a conventional ornamental space in gold and red, in many cases a meander, divides the surface to be decorated into separate fields, on which the paintings proper, human figures, flowers, birds, clouds consisting of single points of iron-red, are represented. Sometimes, too, these pictures are executed in enamel colours, although this is much less frequent than in Seto-mono. Many articles of Kutani-yaki are among the most beautiful that ceramic industry in general has ever furnished, because of their extremely careful and effective decoration. The character of this decoration may be distinctly seen in the heliotype on Plate XXII.

Banko-yaki. The province of Ise yields, under this name, in the cities Yokkaichi and Kuwana, on the Tôkai-dô, as well as in several towns between them, partly flint-ware and partly a kind of glazed earthenware with beautiful enamel decorations, which has been called very aptly Japanese Majolica. In a narrower sense, however, Banko-yaki consists of clay-wares having a red to dark brown, yellowish, or white colour, either plain, marbled or painted. They are extremely tasteful, but thin, light, and not very durable, burning very hard, and exhibiting in the potsherd quite the character of stone-ware. They are generally smaller articles, tea-pots, jugs, small vases and several others which are formed neither on the wheel nor by the hand, but in adjustable katas or moulds. The ferruginous clay which is used for the coloured ware is obtained in several places on a neighbouring hill near Obuke; the white ware is from the porcelain material of Seto. When the two kinds have been finely pulverized and washed, pressed through cloths and transformed to plastic paste, they are separated for the plain wares and mixed for the marbled; *i.e.* in the latter case they are superficially kneaded together, and then rolled to a thin paste like cake dough. The adjustable wooden moulds, having a long prismatic or cylindrical piece as a handle in the middle, are made wet and covered with strips of oiled or Shibu-saturated paper. The sheets of doughy paste are then pressed firmly on all parts of the mould. That which lies over the edges is trimmed off. Special strips of the material are laid on and pressed close together to form the neck; the bottom also is cut out by itself and pressed on. The same is done with the handle and spout, which must be ready made beforehand. When the pot is thus modelled on the kata and somewhat dried, the form is taken apart and out from the centre, and the article placed to dry, after which the strips of Shibu-gami may be easily removed. The cover is formed separately also. The burning lasts twenty-four hours and the articles are not glazed.

The four pots on Plate XXIII. are decorated each in a different fashion. The rings and knobs of the covers of the two upper pots may be turned easily. The vertical striping of both is effected by a pressure of the material upon the form. The white pot (upper left) is decorated with birds and blooming branches; the greyish brown at the right, with the white botan blossom (pæony), laid in with a corresponding material. The third pot (lower left) shows the places where the thumb pressed the thin dough on the form. The little house with which it is decorated is made of paste applied to the paste of the pot. In the fourth a peculiar marbling may be noticed, produced by a mixture of several coloured pastes. Wares of this kind are called Momi-kome, or Kamo-gata.

Banko Kichibei, after whom this flint-ware or "Grès de Banco" is named, erected a furnace at Yeddo, between 1652 and .1660, which was intended as a branch of the factory in Kutani, but was given up later. Forty years ago, a porcelain potter, by the name of Yiusetsu, built a furnace in the village of Obuke, near Kuwana, changed his name into Banko, and laid the foundation of the present peculiar industry which bears his adopted name. Its principal seat is Yokkaichi, on the Tokai-dô, where the manufacturer Kawahara-ya employs about eighty workmen. The factory in Obuke is still in operation, but furnishes more majolica, with beautiful enamelled decorations in relief. Several potters from Yokkaichi transplanted the industry to Onko in Mino, and are now producing many durable wares.

It remains still to mention Imbé-yaki, a peculiar stone-ware from the province of Bizen, which, when burned in an intense fire, is distinguished by a beautiful brownish red colour, and resembles certain Chinese wares of a similar character.

A.—ANALYSES OF THE PORCELAIN MATERIALS OF ARITA, IN HIZEN.[1]

	I. Tsuji-tsuchi.	II. Arita-stone.	III. Arita-stone.	IV. Tsuji-tsuchi.	V. Sakai-me-tsuchi.	VI. Uwa-kusuri.	VII. Shiro-tsuchi.	VIII. Tsuji-tsuchi.	IX. Sakai-me-tsuchi.	X. Uwa-kusuri.
Silicic acid . .	78·70	77.35	83·00	78·18	78·07	78·21	77·68	78·27	77·88	77·05
Alumina . . .	14·27	14·27	11·60	15·70	13.99	14·41	15·19	14·69	14·78	15·28
Ferric oxide .	1·16	2.11	0·70	0·66	1·02	1·41	0·90	—	—	—
Manganic oxide	—	traces	traces	—	0·03	—	0·01	—	—	—
Lime	0·45	0·15	0·18	traces	0·19	0·10	1·46	0·44	0·33	0·40
Magnesia . .	traces	0·29	traces	0·10	0·23	—	0·10	—	—	—
Potash . . .	2·24	1·78	1·90	0·55	0·96	0·14	0·51	4·23	3·55	3·98
Sodium oxide .	—	0·32	0·09	1·74	1·72	1·38	1·47	—	—	—
Water	3·29	2·76	2·49	2·52	3·32	3·72	3·33	2·99	2·84	2·91
	100·11	99·03	99·96	99·45	99·53	99·37	100·65	100·62	99·38	99·62

[1] These Japanese names are not terms for the Arita porcelain-stones themselves, but for material made from them.

B.—Analyses of Porcelain Materials from various sources.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
	Ama-kusa-ishi.	Kutani-ishi.	Tono-kuchi-ishi.	Kaseda	Porcelain-stones from the quarries of Ki-mönnhsien, at Kingte-tschin, in China.			Pegmatite from Yükan, in China.		Pegma-tite from St. Yrieix.
Silicic acid	73·87	76·60	78·72	77·15	74·77	75·42	77·75	74·70	77·00	74·99
Alumina	15·25	14·75	14·51	13·50	16·29	16·45	15·38	15·70	15·00	14·80
Ferric oxide	0·73	·0·86	traces	0·94	—	—	—	—	—	0·37
Manganic oxide	—	—	"	—	—	—	—	0·10	—	—
Lime	0·43	0·29	"	0·83	2·61	0·74	1·26	0·10	0·20	1·09
Magnesia	—	—	0·42	0·62	—	—	—	0·20	—	0·36
Potash	5·46	3·91	0·39	3·34	2·81	2·45	3·32	6·40	4·70	4·31
Sodium oxide	1·07	0·65	—	1·85	2·05	2·34	—			3·49
Water	2·23	2·68	5·34	1·64	2·42	2·74	2·51	2·40	2·40	0·65
	99·04	99·74	99·38	99·87	100·95	100·14	100.22	99·60	99·30	100·06

Explanations of the foregoing tables.

A contains several analyses of Arita-ishi, the basis of the celebrated porcelain industry in Hizen ; and *B* contains analyses of porcelain stones of varying origin and character.

A I., *B* I., III. and IV. were made by Dr. C. Sarnow, in the Royal Porcelain Factory at Charlottenburg, and published in the *Thonindustriezeitung*, 1878, No. 28. I myself collected the material in Japan. Sarnow makes the following notes: *A* I., Arita-ishi. "White, stony substance, with numerous black spots in it ; almost capable of resisting the porcelain-fire." *B* I., Amakusa-ishi. "White, stony substance, yielding, when broken to pieces, a white powder, which, mixed to consistency with water, melts at the temperature in which the porcelain of the Royal Porcelain Factory of Berlin is burned." *B* II., Kutani-ishi. "Stone of a yellow colour, or yellowish white, threaded with yellow veins, and showing indications of melting in the porcelain-fire." *B* III., Tonokuchi-ishi, kaolin, from the vicinity of Lake Inawashiro. "The pieces are of a yellowish white colour, very resistible to fire, and burning quite white."

A II. and III. are analyses of Arita-stone, published by Gümbel in *Dingl. Polyt. Journ.*, Bd. 227, p. 501. He obtained the material through Dr. G. Wagener, from the Vienna Exhibition.

The analyses *A* IV., V., VI., VII., were made by H. Wurtz, and are reproduced by Atkinson in Vol. VIII., p. 273, of the "Transactions As. Soc. of Japan," 1880. In the same article, R. W. Atkinson gives a number of his own investigations of the materials employed in Japanese ceramics, and *B* IV. is taken from these.

The last three analyses of table *A*, as well as *B* V., VI., and VII., were taken from the "Untersuchung von Chinesischen und Japanischen zur Porzellanfabrikation verwandten Gesteinvorkommnissen," von W. Pabst in the "Zeitschrift der deutsch. geol. Gesellschaft," Bd. 32 (1880). F. von Richthofen furnished the samples, besides notes on occurrence in Japan and at Arita. According to these, von Richthofen regarded Arita-ishi as a tertiary, unstratified rock, rich in silicic acid, and resembling rhyolith-tufa, while the porcelain-stones of Kingte-tschin have great similarity to "Hälleflinta" and Petrosilex.

The porcelain-stone of Yükan, of which *B* VIII. and IX. are two analyses by Salvétat, are called by him pegmatite, and by von Richthofen porphyroid. *B* X. is an analysis of the pegmatite of Yrieix, in France, published by Seger, and placed here for purposes of comparison.

C.—Analyses of various Japanese Kaolins and Clays, compared with some of other countries.

						Washed Normal-kaolins.			
	I. Shiga-raki (near Kiôto).	II. Seto (Owari).	III. Kuwana (Ise).	IV. Kiri-shima-yama (Osumi).	V. Arita (Hizen).	VI. Kingte-tschin (Kiang-si).	VII. Zettlitz (Carlsbad).	VIII. St. Yrieix (Limoges).	IX. St. Austell. (Cornwall).
Silicic Acid . .	56·87	54·65	64·65	59·42	49·25	50·64	45·68	54·40	48·35
Alumina . . .	28·56	32.35	22·56	27·90	38·89	32·74	38·54	49·30	36·00
Ferric Oxide . .	0·98	—	1·46	—	1·14	0·95	0·18	—	0·75
FeO and MnO .	—	—	—	—	—	2·52	—	—	—
Lime.	0·69	0·90	0·22	0·13	0·15	0·50	0·02	0·65	traces
Magnesia . . .	0·47	0·37	—	0·26	0·36	0·27	0·15		
Potash	2·08	3·27	0·03	0·61	2·01	2·52	0·66	2·35	0·96
Sodium Oxide .	0·06	2·22	0·30	1·01	0·39	traces			
Water	10·16	6·30	10·34	11·55	5·90	10·00	13·00	—	13·00
	99·87	100·06	99·56	100·88	98·09	100·14	98·23	106·70	99·06

D.—Analyses of various Porcelain Pastes.

	I. Arita.	II. Arita.	III. Seto.	IV. Kiyo-midzu (Kiôto).	V. Berlin.	VI. Sèvres (Paste for Plates.)	VII. Sèvres (Paste for Sculp-turing.)	IX. Limo-ges.	X. China.
Silicic Acid . .	74·53	71·31	64·70	67·17	63·07	58.00	64·23	66·71	68·00
Alumina. . . .	16·09	19·74	22·01	21·50	24.67	24·40	30·05	21·58	12·00
Ferric Acid . .	1·03	0·73	0·74	0·68	0·59	—	—	0·47	traces
Lime	0·06	0·17	0·57	0·56	0·42	4·50	2·89	0·61	14·00
Magnesia . . .	0·25	—	—	—	—	—	—	0·37	—
Potash	4·37	4·04	4·95	4·97	} 4·25	3·00	2·79	2·93	} 6·00
Sodium Oxide. .	1·10	0·10	0·36	—				1·62	
Water	2·83	4·01	6·06	5·85	7·00	—	—	5·54	—
	100·26	100·10	99·39	100·73	100·00	89·90	99·96	99·83	100·00

C. Analyses of various Kaolins and Clays.

Of these R. W. Atkinson published Nos. I.–IV., in "Transactions As. Soc. of Japan," vol. viii. pp. 274, 275 ; Gümbel, V., *Dingl. Pol. J.* Bd. 227, p. 501 ; Kalmann, VI., in *Dingl. Pol. J.* Bd. 220, p. 445 ; and K. Bischof, VII., VIII., and IX., in *Dingl. Pol. J.* Bd. 198, p. 396. As can be seen by comparing them, the Arita-kaolin, which is found in company with the Arita porcelain-stone, and must be regarded as only a further developed form of this, comes next to the normal kaolin from St. Austell, in Cornwall. Its burning is facilitated by its high amount of alkali, which is of great value for the porcelain industry of Arita. Of the other Japanese porcelain clays in the table, Shiga-raki is used not only for Kiôto Faïence, but for porcelain ; and the kaolin of Kirishima-yama is used for the Faïence of Satsuma. That of Seto supplies the porcelain factories of Owari and Mino, which employ, besides, many other clays. The clay which is used for the lighter Banko-yaki is found at Kuwana in Ise ; and a reddish clay with over 5 per cent. of ferric oxide, from which, for example, the vessel in Fig. 19 was made, is also found here in Ise as a valuable material for its own peculiar industry.

Table *D*, "Analyses of various Porcelain Pastes," offers matter for interesting comparisons. The first two, of Arita-substances, are especially notable for their large amount of silicic acid. They, like No. VIII., were published by Seger and Aron, in the "Thonindustriezeitung." The director of the experiment-station at Charlottenburg, so well known for his notable labours in the subject of ceramics, remarks upon these as follows : "The Japanese paste I.

exhibits the highest degree of plasticity, so that, in view of the small amount of argillaceous cement, it is hard to believe that a real plastic clay has been employed." And indeed this is not the case. The substance, like the porcelain-stone that yields it, is unique in the porcelain industry.

For analyses III. and IV., I am indebted to Dr. Sarnow. He remarks of paste III. that it is yellowish grey, tolerably plastic, and that it burned white, and is of nearly the same resistibility to heat as the Berlin pulp. The paste of Kiyomidzu shows the same properties. In chemical composition these three materials approach one another, though the Berlin paste is richer in alumina, and correspondingly more resistible in firing. The porcelains of both districts correspond to the near relationship of the Seto substances to that of Kiôto. Analyses VI. and VII. are by Laurent, and were, like IX. taken from Kerl's "Handbuch der Thonwaaren-industrie." The large amount of lime and alkali in the Chinese paste IX. renders the porcelain obtained from it very easy to melt, approaching the English paste for soft porcelain substance.

9. Enamel Industry.

The Nature and Varieties of Enamel.—Historical Glance at the Development of the Industry in different Countries.—Character of the Chinese and Japanese Cloisonné.—Method of Cellular Lacquer-work Manufacture in Japan on Copper, Porcelain, and Stone-ware.—Free Enamel.—Composition and Preparation of Japanese Vitreous Colours.

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Enamel, Japanese Shippô, is the name given, first, to an easily fusible glass material coloured by a metal oxide, produced principally on metals, less frequently on clay-wares and glass, either as a protecting covering or for mere decoration, second, the article decorated with enamel. Under the first head the base (the excipient) is evenly covered with enamel of one colour, *e.g.*, in modern times many household articles of cast-iron. Such an enamel corresponds to the glaze of earthenware, from which it is also difficult to distinguish it in the composition and use.

If the enamel is to serve as decoration merely, it is treated like painting colours. The pulverized mixture of its constituents is ground to a fine paste with water and laid upon the groundwork with a little stick or brush, and then fused at a moderate heat in a small furnace. This enamel decoration is usually executed in several colours, like the polychromatic painting of clay-wares. As the enamel colours may be both opaque and transparent, they furnish a very rich palette which makes it possible to imitate the appearance of several ornamental stones, thus giving rise to the Japanese name Shippô, for enamel, and Shippô-yaki for enamelled metallic vessels.[1]

Enamel decoration is an art which has been practised by many civilized people in ancient as well as in modern times, and in which the Japanese especially show marvellous skill. While other nations, especially the Chinese, have contented themselves with decorating metals only in this way, the Japanese have succeeded with equally good results in using it on hard-burned clay-ware (porcelain and Faïence). But before I describe more closely the manner in which the Japanese produce their enamel, I will make some general observations on the varieties of enamel and its introduction. The several processes of enamel decoration are grouped in two classes:

1. Bound enamel, also called incrusted or imbedded enamel. This is a mosaic work in which the single enamel colours and constituents of the decoration are separated from each other by a narrow metal band. In its manufacture a network of metallic cells is made on the foundation, either by casting, hollowing out or soldering, which corresponds to the contour of the single parts of the picture. The cells are then filled, either entirely or partly, with the several enamel colours, and then comes the fusing or burning, in which the thin cell walls prevent the overflow of the different enamel colours; and after being rubbed down make the contour of the different parts of the enamel picture sharply distinct.

This bound enamel is again divided into:

a. Cell enamel, or cloisonné enamel (incrusted enamel), in which the cells are formed separately of narrow metal bands corresponding to the pattern of the decoration, and then soldered to the foundation.

b. Pit enamel, or enamel champlevé (embedded enamel). In this variety the cell walls are parts of the groundwork itself, and are produced, like the enclosed hollows, by casting or carving out.

In both these varieties of enamel the fused colours fill up the cells completely after the rubbing and polishing, so that the deco-

[1] Shippô-yaki signifies "The burned ware of the seven costly things" (Shippô, see p. 424), because gold, silver, lapis-lazuli, coral, agate, rock crystal, and pearls are imitated to a certain degree and can be combined in this kind of cell-enamelling.

rations lie in an even surface. On this account it is also called surface or smooth enamel, an expression which is employed by the Russians especially for this kind of product. Another kind of cell enamel is made in Moscow, and there only, viz.:—

c. The so-called filigree enamel is called by the Russians Filogranuije enamel or Soskanju enamel, *i.e.* literally "enamel with twisted thread." It differs from the smooth enamel in this, that only the bottom of the cells is covered with the enamel colours and the cloisons or cell walls stand out in relief.

2. Free enamel is laid on with the brush, not in cells but upon the smooth metallic surface. It is distinguished as painted enamel (émail de peintre) or Limoges, after the city in which it was principally employed in the 15th and 16th centuries with remarkable effect, and as translucent (émail translucide), raised or high enamel (opera di basso rilievo). The ornamentation, which is formed by the embossing and cutting of the metal foundation itself, or by means of a putty in surface relief, is painted with transparent enamel colours, so that the lustrous metallic groundwork is seen through the crust of enamel.

The origin of flat enamel, with which we have principally to do, belongs to a period before the Christian era. The old Egyptians filled gold cells with polished costly stones or glass, and I saw in 1878, in the Musée de Cluny at Paris, a piece of bronze bearing the number 3510 (a clasp) which was similarly treated. It was about five or six centimeters long and broad, with dice-shaped hollows filled out with polished coloured stones. Whether it was really of Celtic origin, as the label stated, or was made rather by the Romans, is of no consequence here. It is certain that the next step was to fill these cells with enamel colours instead of coloured stones or pieces of glass.

Articles decorated with Cloisonné enamel in ancient times are infrequent and usually small. The groundwork was almost always of embossed gold or silver. The cells were small strips of gold soldered in. Pit enamel soon followed. In the flourishing period of the Eastern Empire, especially at the time of Justinian, who was able to use his great wealth to gratify his taste for magnificence in churches and castles, weapons and armours, Byzantine enamel (cell and pit enamel) was brought to its highest development in Constantinople. It is not known whether the Byzantines discovered the art or learned it from the orientals; the assumption that it came from the Chinese, on the other hand, is entirely unfounded and erroneous. It gained entrance to Western Europe and firm foundation undoubtedly by means of the crusades. Its greatest display was in the 13th and 14th centuries, as can be readily seen by its products in the art collections of many old Catholic churches, for example, in the cathedral at Aix-la-Chapelle. Decoration with precious stones, some of which stand out above the enamel, was combined with the electrum, as enamel was called during the middle ages, as Theophilus[1] has stated and is shown by numerous examples. Enamelled reliquary shrines were especially popular, and not only these but coffins, altars, crucifixes, censers, and other ecclesiastical vessels were decorated with pit enamel, also weapons, girdles, and all kinds of ornamental articles. Instead of precious metals for the foundation, they gradually employed the cheaper copper, on whose polished surface the decorations were sketched and then hollowed out with the graver's burin. It was not till some time later that this work was materially lightened by first casting and then engraving. Pit enamel on copper, like cell enamel on precious metal, made the decoration of large surfaces possible in an entirely different manner, and was predominant in Europe, while Cloisonné enamel found its chief employment in China and Japan.

German inhabitants of Lorraine introduced pit enamel into Paris. Thence it passed down in the 12th century to Limoges, where it had an extremely flourishing existence. But as in the 15th century the art declined in the favour of the public, the Limoges enamel, or enamel painting of Limoges, in which the art of enamelling in general has shown its greatest accomplishments, began to be developed. In the 17th century the still flourishing Faïence industry succeeded this enamel painting in Limoges, and was joined in the 18th century by the porcelain industry. The art of decorating metallic objects with surface enamel, and especially pit enamel, gradually disappeared in Europe towards the end of the Middle Ages, without entirely dying out. Its first revival occurred in the 17th century at the "time of the Patriarchs and Czars," in Moscow, through the influence of Greek masters. Bishops' caps, crucifixes, sceptres, imperial globes with their crosses, shields, swords, quivers, and many other articles were decorated with stones and enamel. But this enamel shows, like modern European cell enamel generally, much more brilliant colours. The cause lies undoubtedly in a difference in process. While in former times, and in Japan and China until within a very few years, the colours were mixed with the other constituents of the cell enamel and combined in the cells or pits by heat to a glassy paste, pieces of coloured glass are now employed. They are thoroughly pulverized and then ground with water to a fine paste with which the cells are filled and again fused. This produces the easier and more perfect filling of the cells, and no less the higher brilliancy of the modern work. They are manufactured in Moscow principally, by the firms Hlebnikow, Ovtschinnekow and Sazikow, though in St. Petersburg also. These Russian productions, with all their magnificence, however, lack often the correct taste in combination of the colours which so distinguishes the works of Ravené

[1] Theophilus, or Rugerus, who lived during the middle of the 11th century, gives in his manuscripts "Diversarum artium schedula," the first description of the manufacture of Cloisonné enamel.

in Berlin, and Barbedienne in Paris. These costly articles with pit enamel are seldom seen in Germany. The deceased L. Ravené was the first and only one who endeavoured to found this industry in Germany. His manufacture of smaller articles, like brooches and cuff buttons, was all that found sufficient support, while for larger productions, in spite of their marvellous execution, there was no sufficient appreciation, and on the other hand facilities for making them were wanting.

Barbedienne in Paris had a much better field for his work. Twenty years ago, when the first larger articles of Cloisonné enamel came from Japan, he endeavoured to imitate them. Several other bronze manufacturers, like Christofle, followed his example. They soon succeeded in decorating vases, plate, and other articles, with cell enamel as beautifully as the Chinese and Japanese, but with such an expenditure of time and money as made competition with Eastern Asia impossible.

It has never been exactly determined how long the art of enamelling was practised by the Chinese, nor when it was communicated by them to the Japanese, but it seems scarcely doubtful that it was not known in either of these countries before the invention or introduction of the porcelain industry. After the sacking of the treasures in the Summer Palace at Pekin in 1859, the French brought to Paris, among other art treasures, some Cloisonné enamel on copper, consisting of pieces with inscriptions and marks which left no doubt as to their origin in the time of the Ming dynasty (1368–1645 A.D.). No older specimens of enamel have been received from China.

According to Japanese statements whose correctness we have no reason to doubt, the art of manufacturing Shippô-yaki was introduced into Japan near the close of the 16th century by Hirato Hikoshiro, and established itself at Nagoya in Owari, where it still has its principal seat. The industry is carried on there and in several neighbouring places, among them in Toshima, 3 ri west of Nagoya, in about thirty houses, generally as a small trade. About twenty or thirty years ago it was also established in Kiôto, Ôsaka, Tôkio, and Yokohama. Here they have not stopped with enamelling copper vessels, but the process has been successfully extended to porcelain (Tôki). Nagoya consequently furnishes now-a-days Tôki-shippô, as well as Shippô-yaki, *i.e.* Cloisonné enamel on porcelain and copper. Still another peculiar kind of decoration is seen in the products from Seto, especially on flower vases, bearing the name Shippô-urushi. The surface to be decorated is covered with a network of brass cells, which are filled not with enamel colours but with the groundwork material of the lacquer industry, and finally painted over with lacquer colours.

Thirty years ago Japanese enamel was not at all known in Europe and was not to be found in any of the old collections with the Japanese lacquer ware, bronzes, and porcelain. The reason of this may be that Shippô-yaki was not manufactured on the island of Kiushiu and even in these days is seldom to be had there, even in Nagasaki.

Although the Chinese also make email champlevé, the Japanese have not followed them. Their older Cloisonné enamel is quite as dull in colour as the Chinese, but amateurs of both give the Japanese the credit of a bolder design and better execution. The Chinese began also earlier to give brighter colours to their cell enamel. Do the duller enamel colours of both nations correspond to the taste—a better taste in the opinion of many—and did they have their origin in this, or were these colours only a natural consequence of the process of manufacture? European connoisseurs and collectors of these old enamels are generally inclined to take the first view, but on closer investigation of the earlier processes of manufacture the cause seems to be found in that alone.

The older Japanese Shippô-yaki has a foundation of thin embossed copper, and for cloisons it has thin brass bands like those used at present, some of which were made probably by beating or by the rolling of brass wire. Azure blue, yellowish green, and a dirty white are its most common colours, but a Turkish blue ground is generally used. In the newer work the groundwork is thicker and the colours used seem far more abundant and brilliant, besides filling up the cells much more evenly and perfectly.

The process of the manufacture of Japanese Cloisonné enamel is, as I had the opportunity to observe, everywhere essentially the same. That of a factory at Ôta, near Yokohama, where fifteen years ago fifty persons were employed to apply the cell enamel to vases, tea boxes, flat plates, dishes, and several other copper articles, will serve as an example for all.

The prepared dishes are provided with a brass edge folding over the top towards the inner and outer side, and with a brass rim soldered on at the foot. The decorations are sketched, generally after patterns, with a white-lead varnish. The workman then covers the pattern with a transparent pane of glass and places on it the cells, which represent the contours of parts of flowers, leaves, feathers, etc., or even of figures. These cells are to serve as the ornament for the entire surface, and correspond exactly to the picture pattern, with their narrow strips of brass, which are either cast or bent by the workman, as he requires them, with a pair of wire pincers. In the latter case, they must have been heated beforehand, in order to take off their elasticity. When he has placed the figures—*e.g.* a flower or a net of meshes—together in this way, the metal strips naturally stand upon their narrow edge, and are then applied to the corresponding design on the article to be enamelled. The Biyaku-gu, or bulb of an orchid called Shuran[1] (*Bletia hyacinthina*, R. Br.), furnishes the cement for

[1] I found this species of orchid, known by its splendid red flowers, in great abundance in Southern Japan on a bare hillside. It was introduced in 1802

fastening them, a sort of salep-glue. It is ground down upon a rough sharkskin (Same-no-kawa), and made into a thick pasty fluid with boiling water. It is then laid on with a brush in the designated places, and the cell walls are placed upon it. When dry they adhere so firmly to the groundwork that the workmen can now proceed to the melting of the solder.

This Rô (solder) is a grey substance made by melting together 8 parts of brass, 7 parts of tin, and 10 parts of zinc. When it is to be used, 10 parts of this pulverized alloy are taken with 3 parts of borax, and enough water is added to make a pulpy paste, with which the groundwork is coated at the places where the cloisons come in contact with it. The article is then heated over a moderate coal fire, so that the solder soon melts. When cooled, the cell walls are firmly fixed, and are now ready for the soft enamel colours.[1]

The solder (Rô) which is used for Awata ware in Kiôto contains 6 parts of brass (Shinshiu), 3 parts of zinc (Totan), and 10 parts of borax (Hôsha). When the metals have melted together, the still hot alloy is placed in a stone mortar, pulverized, mixed with borax, and then ground with water to a paste which can be laid on with the brush.

The article designed for enamelling, and provided with firmly adhering cells, passes now into the hands of the painters. These are generally women, who sit in a circle around their pots containing different colours. There is usually a thorough division of labour in this work, of such a kind that each person represents one colour. She dips a little staff in the prepared coloured pulp paste and fills one cell with it; then the second, which should receive the same colour; and so on. Thereupon the article goes to the hands of the second painter, who proceeds in like manner with her colour; and thus the work goes on, till all the colours are laid on and all the cells are filled. When the enamel has become as dry as is possible in the open air, its burning follows. The colours shrink considerably, and holes are formed in the enamel, so that there must be a continual filling up of the cells. Then comes the second burning, and afterwards the first rubbing and polishing. The cracks and other hollows in the cells are again filled up and improved, then burnt for the third time, and often a fourth, and once more rubbed and polished. Cracks and holes which still appear are often filled and painted over with Rô (vegetable tallow), a deceit which should be avoided. The older Chinese and Japanese enamels show these imperfections in great number, especially the

into England, and appears to be identical with *Epidendrum tuberosum*, Lour. (Lour. "Flora cochin-chinensis," p. 639), concerning which the author states that it is cultivated in the gardens of China and Cochin China.

[1] Enamel workmen in Nagoya assured me that they did not use any Rô, but filled in the enamel colours as soon as the cells had been fastened down with Biyaku-gu.

holes. They appear almost as a necessary attribute of the entire character of the work.

The burning in of the enamel colour is accomplished in a manner similar to that of the colours on clay-ware, in a simple apparatus not very well suited to the purpose, which may be described as a muffle without a furnace. Fig. 20 gives an illustration of such a one as was used at Awata in Kiôto some fifteen years ago. The muffle is made of Kawarake, or brick-paste. Its size depends on that of the objects to be enamelled. In this case it was only 15½ Japanese inches (50 centimeters) high, and 12½ inches (38 centimeters) broad. The hole in the cover, 5 or 6 centimeters wide, is used for testing. The muffle usually admits only one article decorated with enamel colours. There are no special conditions in regard to fuel; charcoal or carbonized wood is placed around the muffle, and heaped up to the top, and then kept tight together with iron wire. The cover is put on with a long pair of tongs when the flames have reached the upper edge. The fire is generally kept up for two hours, and removed quickly as soon as the test shows a perfect fusing of the enamel colours. The cover, however, for reasons easily understood, must not be taken off till after a sufficient cooling.

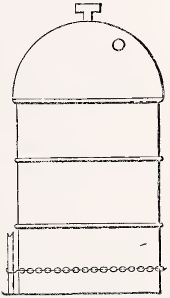

Fig. 20.—MUFFLE FOR BURNING IN OF ENAMEL COLOURS.

The same substances which are used for the purpose in the lacquer industry serve for rubbing and polishing the cell enamel-work, viz., coarse and fine sandstone, slate, and magnolia charcoal, after the second, third, or fourth burning, with ashes of hartshorn and rape oil for polishing.[1]

Substantially the same process is followed in the manufacture of Tôki-shippô, or émail cloisonné on porcelain, in Nagoya and Kiôto, and of Awata-shippô or on Awata-yaki in Kiôto, as in Shippô-yaki. Those parts of the clay-wares under consideration which are to be decorated with cloisonné enamel must remain unglazed. The others are treated in the usual way, *i.e.* with strong fire colours under glaze and with muffle colours on the glaze. When this is done, the net of brass cells, *i.e.* the contour of the leaves, flowers, and fruits, of animals, and the other several constituent parts of the meander and other figures—in short, of all the single elements

[1] The order in which the above-mentioned polishing materials are usually employed is as follows: 1. Ara-to, a coarse-grained grey sandstone from Shinano; 2. Iyo-to, a sandstone from Iyo; 3. Omura-do, a fine-grained white sandstone from Omura in Hizen; 4. Joken-ji, a yellowish clay sandstone; 5. Tsu-shima-ishi, a slate whetstone from the island of Tsu; 6. Hô-no-ai-sumi, magnolia charcoal.

which are to make the whole enamel decoration, is then placed in the same as upon copper. The contour of these cloisons is sketched beforehand with Indian ink. For fastening the thick pasty glue made from the bulbs of Bletia hyacinthina is used, but no solder or Rô. When the cement is dry the cells are filled with the pulpy enamel colours, as in other cases. In this case also the single air-dried colours are not fused separately, but all at one time, and practice and experience have shown how to prepare the mixtures by a number of different fluxes, so that the fusing of all becomes possible in the same degree of heat. On account of the shrinkage of the enamel in burning and the escape of air bubbles, cracks, holes and hollows appear, which must be filled up. Then follows a second burning, then the first polishing, another filling up, and a third burning, to which often a fourth is added.

In Awata-yaki polychromatic painting is combined in a very effective manner with the decoration by means of many-coloured cell enamel. Those parts of the article which are destined for the latter form sharply defined medallions of various figure and size, which lie usually about one millimeter below the surface. This kind of decoration is copied on the copper basin seen in Plate XXIV., but changed as required by the composition of the groundwork. We see there a medallion which is surrounded or framed in by a large, thick-walled brass cell, and filled with white enamel. The decorator has then applied green and blue muffle colours and gold to the coloured picture on this enamelled groundwork, and the whole has been burned in. Here too the application of the enamel must have preceded the ornamentation of the medallion with the pæony and flying butterfly.

Nagoya was not only the first to develop the cell enamel on copper, but some twenty years ago was in advance of Kiôto in transferring the process to crockery. Porcelain vases from Seto were here decorated in another peculiar way which is known as Nuri-shippô or Shippô-urushi. It is a peculiar form of ornamenting clay-wares by lacquer painting. A net of brass cells is placed on the surface, the same as in Tôki-shippô, but the cement used is not Biyaku-gu, but rather a mixture of paste with Seshime-urushi. Instead of enamel colours for filling the cells, the well-known groundwork materials of lacquer work are used, a paste made of Tonoko and water; and then the Sabi or Tonoko is mixed with Seshime. When dry, the article is polished with sandstone, the Omura-do, and then receives a coating of Seshime and Ro-iro-urushi as the final process of the groundwork. The further decoration and treatment answers entirely to that of the lacquering of other articles. Naturally the polishing must be continued each time till the brass cells appear on the surface, which excludes the employment of raised lacquer work.

A free enamel painting is also employed in Japan with the best

Copper Vessel with Email cloissonné and painting.

Wilhelm Engelmann, Leipzig.

results. In clay-wares this is often combined with the common decoration, and thereby pictures of flowers, butterflies, birds, and other objects are produced, which are burned in with the muffle colours, and then appear as surface reliefs. This fine addition to the porcelain and Faïence painting has been employed for a long time with cobalt enamel on Seto-mono, and with several other enamel colours on Banko-yaki and Awata-yaki. In Awatashippô it heightens the charm of the many-coloured pictures which adorn the above mentioned sunkèn medallions.

Cast-iron vessels also, particularly water-kettles, have been painted for the last fifteen years with opaque enamel colours at Kanazawa, the industrial capital of Kaga. The Royal Industrial Art Museum at Berlin has several fine specimens of this peculiar and highly pleasing relief decoration. They are cast-iron kettles and pans made by the Sano Nobuteri in Kanazawa, the inventor of this peculiar kind of enamelling.

Since 1875, Japan has made great technical progress in enamel industry, as well as in the working and decoration of metals, and has successfully overcome a number of difficulties with astonishing skill. While the enamel colours were formerly used together in the cells with their accessories, they are now treated more and more after the European manner, and coloured glass flux is used instead of pulverized mineral colours. This coloured glass is stamped fine and, with the addition of water, ground to a fine paste; the cells are then filled and it is again fused. In this way much purer and more brilliant colours are obtained than was possible formerly. In order to preserve the lustre it is necessary that the last enamel colour, applied as a thin coating after the burning, should not be further polished. The employment and shading of transparent enamel, and the gradual toning of one enamel colour into another, *e.g.* from sky blue to evening red, are undoubtedly among the most progressive steps in this department. As in the inlaying of cast-iron vases and plates, so also in this enamel work, the decoration of the open spaces which surround the many-coloured pictures of cell enamel on the medallions, geometrical figures, the Buddhist cross cramponée, the Greek fret, and other straight-lined elements of decoration which are formed with thin brass strips and filled with an enamel colour, are used in preference. Enamel pictures of uniform enamel covering and blue or white colour are seen much oftener without a framing of all the cells.

The criticisms on the new works differ very widely in regard to their artistic quality. Wherever the taste has been formed by the dull but harmonious colouring of the older Japanese cell enamel a departure from the old methods is observed with regret, and the modern efforts are held in smaller estimation. They are regarded as degenerate specimens, and one misses the old force in the composition, the delicacy in colour, and the care in execution. On the other hand, and especially in Germany, the modern enamel works of the Japanese, such as were brought forward in the Exhibition at Nuremberg, in 1885, have met with the greatest approval among those no less competent to judge. The drawing, grouping, and colouring, and especially the perfect harmony in the many colours of the enamel, are particularly admired.[1]

Supplement.

Composition and Preparation of Japanese Colours.

The enamel colours which are used by the Japanese are the same as those employed in the painting of clay-wares. With the exception of red oxide of iron, white-lead, verdigris, and blue vitriol, and several fluxes, all these colours are imported from Europe. Beni-gara, ferric oxide, is used to produce red, brown, and dark shades of colour. Murasaki, *i.e.* violet, is obtained from peroxide of manganese; Kon-jô or blue, from Tô-gosu, cobalt oxide, and from Gosu (an impure cobalt oxide containing manganese, from Asbolan), Kuro-gosu, or Ao-gosu (mixture of cobalt oxide and peroxide of manganese), or Hana-kon-jô (smalt blue). Roku-shô (Dô-sei or verdigris) is used for the green colour, also chloritic oxide of copper and malachite, which bear the same names, and oxide of copper, while chromic oxide was, at least formerly, unknown, and was used as little as other chromic compositions. Those already mentioned, and other copper combinations in powder form were called also Awo-ko, green (blue) powder, and Daikon (radish green). Yellow is obtained from Tô-shirome or antimony, likewise brown.

Bowes[2] had the colourless ground material of Japanese cell enamel analyzed by Dupré. The composition was found to be as follows:—

Lead oxide	37·15	per cent.
Lime	4·92	"
Magnesia	0·90	"
Soda	5·19	"
Silicic acid	51·84	"
	100·00	per cent.

Therefore, essentially, it would be a lead-glaze,—not an uncommon thing in glazes. And from this we see why they use Yô-no-tsuchi (white-lead), called also Haku-fun, white powder; and Shiratama, or pulverized lead-glaze, in almost all their vitrifi-

[1] See L. Gmelin: "Internationale Ausstellung von Arbeiten aus edlen Metallen und Legierungen in Nürnberg in Jahre 1885." "Zeitschrift des Kunstgewerbevereins zu München," 1885, p. 91.
[2] See Bowes: "Japanese Enamels," p. 15.

able pigments. Hino-oka or Keisan, a silicic earth, is also often used, besides, but more seldom, Hôsha or borax, and Yô-tsuchi, a sort of kaolin.

Dupré analysed red and green enamel pastes also, and found them composed of the following materials :—

Green.		Red.	
Copper oxide ...	6·14 per cent.	Ferric oxide ...	8·62 per cent.
Lead oxide ...	34·89 "	Lead oxide ...	33·93 "
Lime	4·62 "	Lime	4·49 "
Magnesia... ...	0.84 "	Magnesia	0·82 "
Soda	4·82 "	Soda	4·78 "
Silicic acid ...	48·69 "	Silicic acid ...	47·36 "
	100·00 per cent.		100·00 per cent.

The following recipes were formerly used in Nagoya for making dull enamel colours :—

1. White (Shiro)	Shiratama	5 parts.
	Tô-no-tsuchi	3 "
	Hino-oka	3 "
2. Dark blue (Konjô)	Shiratama	5 "
	Tô-no-tsuchi	3 "
	Hino-oka	1½ "
	Kon-jô ... ... (Cobalt oxide)	4 "
3. Light blue (Awo)	Shiratama	8 "
	Tô-no-tsuchi	12 "
	Daikon	25 "
	Awo-ko	30 "
4. Light blue (Usu-awo) ...	Shiratama	20 "
	Tô-no-tsuchi	12 "
	Hino-oka	8 "
	Awo-ko	7 "
5. Rape-green (Na-iro) ...	Shiratama	12 "
	Tô-no-tsuchi	5 "
	Hino-oka	2 "
	Awo-ko	2 "
	Daikon	20 "
6. Yellow (Ki-iro)	Shiratama	6 "
	Tô-no-tsuchi	4 "
	Hino-oka	2 "
	Tô-shirome	0·15 "
7. Dark violet (Usu-kon) ...	Shiratama	100 "
	Tô-no-tsuchi	30 "
	Kon-jô	12 "
8. Red (Aka)	Shiratama	40 "
	Tô-no-tsuchi	20 "
	Hino-oka	25 "
	Benigara	10 "
9. Brown (Cha-iro)	Shiratama	6 "
	Tô-no-tsuchi	2 "
	Tô-shirome	0·1 "
	Kei-san	0·5 "

10. Grey (Nedzumi)	Shiratama	47	parts.
	Tô-no-tsuchi	5	„
	Murasaki-ko	5·8	„
11. Black (Kuro)	Shiratama	5	„
	Awo	5	„
	Kon-jô	3	„
	Keisan	2·5	„

TRADE AND COMMERCE.

IV.

TRADE AND COMMERCE.

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1. Coins, Measures, and Weights.

a.—Money, Kane or Kinsu; Paper money, Shi-hei and Kin-satsu; Bank Notes, Satsu or Gin-kô-satsu.

Since 1871, Japan has had a new system of coinage, whose unit is the Yen, of the same value as a Mexican dollar, or about four shillings.

1 Yen = 100 Sen, 1 Sen = 10 Rin. The following kinds of money are coined:—

a. Copper Coins (Aka gane).	*b.* Silver Coins.
1. Ichi Rin, 1 Rin piece.	5. Go Sen, 5 Sen piece.
2. Go " . 5 " "	6. Ju " 10 " "
3. Ichi Sen, 1 Sen "	7. Ni-ju " 20 " "
4. Ni " 2 " "	8. Go-ju " 50 " "
	9. Ichi Yen, 1 Yen "

c. Gold Coins.

10. Ichi Yen,	1 Yen piece.	
11. Ni „	2 „	„
12. Yo „	5 „	„
13. Ju „	10 „	„
14. Mi-ju „	20 „	„

The Imperial mint in Ôsaka, from which this money is issued, was among the first and best innovations which were made soon after the deposition of the Shôgunate. It was built under the very capable direction of an Englishman, Major T. W. Kinder, arranged after English model, and opened on the 4th of August, 1871. The European patterns were closely followed in the circular form of the new coins. The impressions are not at all behind those of the best European coins in respect to clearness and other requirements. They are bordered and milled, and show on both sides the various emblems and arms of the country, viz., the rising sun, the chrysanthemum blossom, the Kiri- and the Awoi-mon (see vol. i. p. 317), the dragon, and the legends in Chinese characters, together with the value, generally in Roman letters and Arabic figures. During the five years, 1870–1875, in which Major Kinder had charge of the institution, 136,885,541 coins, with a value of 62,421,744 Yen, were stamped at the Mint. Kinder conducted also the analysis and refining processes, and united with the Mint a sulphuric acid and nitric acid factory, whereby the further importation of two important requirements of the chemical industry became unnecessary.

Paper money, or Kin-satsu, which has been known in Japan since the 14th century, is now issued of the respective values of 10, 20, and 50 Sen, as well as of 1, 2, 5, and more Yen, corresponding to the several gold coins. This was effected by means of lithographs from Dondorf's establishment in Frankfort-on-the-Main, which had for a while turned out satisfactorily the new Kin-satsu. Besides the national treasury notes, the Government allowed paper money to be issued by many of the banks that sprang into existence about this time.

Until 1870, there were in use Zeni (Sen), or small coins made of iron, copper, bronze; Gin-su or silver pieces, and Kin-ka or gold pieces, besides various paper bills; all differing in shape and appearance from one another, and from the coins used at the present time. There were pieces:—

a. Of Iron (Tetsu).

1. Ichi Mon,	1 Mon	= 0·01 Sen or about	0·004 pence.
2. Shi „	4 „	= 0·04 „ „	0·008 „

b. Of Bronze (Kara-kane) or Copper (Aka-gane).

3. Ju Mon,	10 Mon	= 0·10 Sen, or about	0·04 pence.
4. Ju-go „	15 „	= 0·15 „ „	0·06 „
5. Ni-ju „	20 „	= 0·20 „ „	0·08 „

c. Of Bronze (Kara-kane).

6. Ichi Tempô, 80 Mon = 3·80 Sen, or about 0·32 pence.

All these small coins had a square hole in the centre, through which a cord could be drawn, so that large numbers, according to trade requirements, could be easily strung together, packed, and carried. They were circular, except the Tempô,[1] which was oval. The iron pieces were withdrawn from circulation in 1873; the oval Tempô not till 1885. The government had them melted for canon. Some of the round bronze and copper coins, however, are still in circulation. Of special frequency among these round bronze coins are the co-called Nami-sen or wave-coins, worth 20 Mon or 2 Rin, and the Bun-kiju-sen, of the period 1861–63, worth 15 Mon or 1½ Rin. Most of the iron 10 Mon pieces now in existence date from the period Kuwan-yei (1624–1643).

The silver pieces that were coined in different periods (Nengô) of the Tokugawa dynasty (1600–1868), mostly containing but little copper, and of very unequal weight, have the shape of little rectangular tablets or bars. These are pieces of:—

1. I'-shû (Ishû-gin), 1 Shu, worth 7·4–17·4 Sen.
2. Ni-shû (Ni-shu-gin), 1 Bu, worth 29·6–46·5 Sen.
3. Ichi-bu (Ichi-bu-gin), 1 Bu, worth 31·77–34·7 Sen.

Towards the end of the Shôgunate the relations of weight and values were more regular. These were:—

1. I'-shû,	1 Shû pieces,	at	6·25 Sen.
2. Ni-shû,	2 Shû „	„	12·50 „
3. Ichi-bu,	1 Bu, „	„	25·00 „

To these were added, as money of account:—

4. Ni-bu,	2 Bu,	at	50·00 Sen.
5. Ichi-riô,[2]	1 Riô,	„	100 „

Besides the three first-mentioned old stamped silver coins, for which there were corresponding paper notes, silver pieces were also in circulation of divers shapes and sizes, named Ita-gin, Chô-gin, etc., according as they had the form of little bars, rounded lumps, etc. They bore the stamp of the Nengô in which they were minted. They contained only a little copper, and were weighed in the presence of the purchaser and reckoned according to an established scale of value.

The older gold pieces are especially interesting. The larger ones were in the shape of oval tablets, known as Ô-ban, Ko-ban, and Nibu-ban, while the smaller had the rectangular form of the silver

[1] The name Tem-pô refers to the period of 1830–1843, in which the larger and heavy coins were struck.

[2] Riô (Riyô), Bu (Bun), and Shû are originally Chinese terms of weight (see apothecaries' weight). One Riô (Riyô) is a weight of 4 Momme or 13,026,084 grammes.

Shû and Bu. An Ôban should weigh about 44 Mon-me (pronounce Momme), and contain 10 Riô, =40 Monme, of pure gold. The Koban should have the tenth part of this weight and amount of gold, and the Ni-bu-ban the twentieth part.

As a matter of fact, however, these coins from the different periods of the Shôgunate of the Tokugawa are of extraordinary diversity in weight, value, and amount of gold contained ; to such an extent, indeed, that an Ôban of the period Keichô (1596–1614), for instance, contained 67·2 per cent. of gold and only 29·4 per cent. of silver, and while weighing 44·059 Momme, was worth 75 Yen ; while the Genroku-Ôban (Ôban from the period Genroku, 1695–1716), which is almost as heavy (its weight being 43·95 Momme), is worth only 59·27 Yen, with 52·11 per cent. of gold and 44·84 per cent. of silver, and the Ansei-Ôban from the period 1859–1862, weighing 30 Momme, has a value of only 28·266 Yen, with 34·35 per cent. of gold and 63·92 per cent. of silver, corresponding to 41·46 Yen for the same weight of 44 Momme. The same thing is true of the Ko-ban of different Nengô. Their weight varied between 4·73 Momme and 2·293 Momme ; their proportion of gold between 86·7 per cent. and 55·94 per cent. ; their value between 10·115 Yen and 1·30 Yen.

In order to free the gold from the large quantities of silver generally united to it, the Japanese always used to employ common salt, with which they melted up the alloy obtained in working the ore. The gold thus purified was called Yaki-kin, *i.e.* burnt or roasted gold (see p. 370). It corresponds very nearly to our ducat-gold. The supposition being that an Ôban of such Yaki-kin was 44 Momme of pure gold, the number 44 was written on the coins with bright black lacquer colour, and they were regarded as the standard for the Ôban that were richer in silver. They were marked with the numbers succeeding 44, beside the proper Nengô, in such a way that, for example, the number 45 indicated 44 parts of gold to one part silver ; the number 46 showing 44 parts gold and two parts silver, etc.

The estimation of gold as shown by its value compared with silver during the long period when the country was closed is very noticeable. According to a decree of the Nobunaga, about the 15th century, 44 Momme of gold should be given for 420 Momme of silver, *i.e.* one part gold for 9½ parts silver. In 1765 this proportion was changed to 1 : 11·35. On the other hand, according to Scherzer,[1] when the country was opened to commerce, in 1855–60, the price was based upon a valuation of the two metals in the relation of 1 : 4·6, since the above-mentioned gold-piece was worth 18½ shillings in London, while in Japan, *e.g.*, at Kanagawa (Yokohama), it could be exchanged for 4 Bu of silver as late as the year 1858. The natural consequence was that gold coins became an extremely profitable, and hence much sought, article of ex-

[1] Scherzer : "Deutsch-Œsterr. Expedition," etc., p. 456.

portation, and in the case of the Ko-ban the price gradually ran up to 8 Bu. In order now to prevent the rapid withdrawal of gold, the government fixed the value of the Ko-ban at 14 Bu, *i.e.* above its real worth in Europe. A return of Ô-ban and Ko-ban to the national treasury now took place, in so far as they were not melted down in foreign countries; hence there was a further loss for Japan. To prevent this, new Ko-ban were at last issued, in 1860, corresponding to the current relative value of gold and silver.

b.—Measures and Weights.

1. *Measure of length.* Its unit is the foot, Shaku or Kane-shaku $=0{\cdot}30303^{m}$. 1 Jô = 10 Shaku = 100 Sun (inches) = 1000 Bu (lines) = 1,000 Riu (strokes) = 100,000 Mo. 6 Shaku = 1 Ken = $1{\cdot}81818^{m}$ = 1 fathom (about), (1 m. = 3′ 3″ Jap.).

2. *Measure of distance.* The unit is the Japanese mile or 1 Ri = $3927{\cdot}27^{m}$. (1 geogr. mile = 1·886 Ri; 28·29 Ri = 1 degree; 1 Ri = 2·44 English miles). The Chinese mile or Li contains only $447{\cdot}19^{m}$ = 0·06 geogr. miles. Accordingly 1 Ri = 8·782 Li.

1 Ri = 36 Chô	= 2160 Ken	= 12,960 Shaku.
1 „	= 60 „	= 360 „
	1 „	= 6 „

1 Shaku = 11·9 English inches.

3. *Cloth measure.* The unit Shaku or Kujira-shôku, *i.e.* fishbone-foot[1] = $1\frac{1}{4}$ Kane Shaku = $0{\cdot}3787878^{m}$; accordingly 1 m. = 2·74 Kujira-shaku. The smaller denominations are the same as in the common measure of length.

One Tan or piece is 26 and more Shaku long. One Hiki = 2 tan of silk stuff, measures 52 Shaku.

4. *Field measure.* The unit is called Tsubo and is equal to 3·305785 square metres.

1 Chô = 10 Tan	= 100 Se	= 3,000 Tsubo	= 110,800 sq. Shaku.
1 „	= 10 „	= 300 „	= 10,800 „ „
	1 „	= 30 „	= 1,080 „ „
		1 „	= 36 „ „

1 Chô = 9917·355 sq. m. = 1 Hectare nearly; more exactly 120 Chô = 119 Ha.
1 Are = 30·25 Tsubo. 1 Ha = 3025 Tsubo.
1 Tatami or Japanese foot-mat = 3 × 6 Shaku = $\frac{1}{2}$ Tsubo.
A single rice-field is generally 1 Tan = 15 × 20 Tsubo.

5. *Measure of Capacity.* For its unit is taken the Shô = 1·803907 liters.

1 Koku = 10 To	= 100 Shô	= 1,000 Go	= 10,000 Shaku.
1 „	= 10 „	= 100 „	= 1,000 „
	1 „	= 10 „	= 100 „
		1 „	= 10 „

Hence 5 Shô = 9 liters.

[1] Because it was made from fish-bone.

The Go contains therefore 180 cm.; the Koku, which is mostly used in measuring grain, while Shô and Go are used for liquids, equals 180 hl. = 5 bushels, reckoning the bushel at 36 liters.

The Shô was introduced in the year 1623. Its inner dimensions are 4″ 9‴ × 4″ 9‴ × 2″ 7‴ Japanese measure. The government ordains that the Go shall be a stout wooden box with a square bottom, its upper edges covered with sheet iron and its cubic contents to be 2·1 × 2·1 × 1·47 Sun. Only such measures are allowed in business as bear the legal stamp burned into each of their four visible outer faces.

6. *Weight.* The unit of weight is called Momme (Monme), *i.e.* the Mon-weight, so designated because the smallest iron coin, Mon,[1] used to be taken as the basis of weight. One Mon-me (pronounce Momme) = 3·756512 grammes; hence 1 gr. = 0·266204 Momme. The Japanese system of weights based hereupon is as follows:—

1 Kwam-me[2] = 10 Hiyaku-me = 100 Ju-me = 1,000 Mon-me = 10,000 Fun = 100,000 Rin = 1,000,000 Mo. 1 Hiyaku-me = 10 Ju-me = 100 Mon-me = 1,000 Fun = 10,000 Rin = 100,000 Mo. 1 Ju-me = 10 Mon-me = 100 Fun = 1,000 Rin = 10,000 Mo. 1 Mon-me = 10 Fun = 100 Rin = 1,000 Mo. 1 Fun = 10 Rin = 100 Mo. 1 Rin = 10 Mo.

The Chinese Pikul = 100 Catties or 1 Hiyak'kin (100 Kin) = 60·104 kg.; 10 Pikuls = 1 Sen-gin (1,000 Kin) = 601·04 kg.

6¼ Kin = 1 Kwam-me, 1 Kwam-me = 3·756512 kg. A Japanese pound or Kin = 160 Momme = 601·04336 gr. 10 Kin = 6·0104 kg., so that 5 Japanese pounds are to be taken to equal 6 German pounds.

The old Chinese subdivision of the pound has kept its place in the apothecaries' weight of Japan. According to it, 1 Kin = 16 Riô or Riyô, 1 Riyô = 4 Bun or Bu, 1 Bu = 4 Shu.

The word Shu designates among the Chinese a sort of Sorghum (Sorghum rubrum), Jap. Kuro-kibi, *i.e.* "black millet," whose dark brown seeds are somewhat pointed on both sides, and are distinguished for singular uniformity. Such a Shu-grain became, 4,500 years ago in China, the basis not merely of weight, but of all measures in general, even measures of sound.[3]

2. Further Means of Intercourse.

All kinds of limitations were added to the natural hindrances of commerce under the long dynasty of the Tokugawa. These were imposed by the system of government upon the people, and were

[1] To the Mon corresponds the Chinese Tsien, called Mace by foreigners, 10 Mace = 1 Tael, 10 Tael = 1 Catty, 10 Catties = 1 Pikul. The Chinese Kin or pound went over to the Japanese unaltered, though the latter have another pound of 180 Momme besides.

[2] Properly Kuwan-me, pronounced Kamme.

[3] For further information on this point, see the above cited treatise by G. Wagener, in the "Mittheilungen der deutschen Gesellschaft Ostasiens."

by no means confined to separation from the outside world. The natural hindrances to commerce are occasioned by the long extended form of the Japanese Empire, and its being split up into many islands, also by its dominating mountainous character and the swelling and overflowing of its numerous rivers during the frequent long rains.

The highways, or Dô, each one of which connects the provinces of a generally long extent of territory, as *e.g.* the Tô-kai-dô and the Naka-sen-dô, served almost exclusively military and administrative purposes. We must not think of them as well-made highways laid out like our own, according to a comprehensive plan, and provided with similar means of conveyance. There are no stretches of macadamized road, and paving is seldom seen, and only in places where the steepness of a particularly important mountain pass makes it necessary, as *e.g.* on the Hakone pass. For this reason most of the Japanese country highways are utterly useless for heavy conveyances in rainy weather. They are not intended for this purpose. Since heavy wagons were not used—indeed, were wholly unknown—and even the Chinese wheelbarrow was only exceptionally seen, people either walked or rode in sedan-chairs, luggage and merchandise was carried almost exclusively by bearers or beasts of burden (horses or oxen)[1] till modern times, the requirements for a solid foundation and greater weight did not exist. Even now, except the numerous Jin-riki-shas,[2] a few coaches which travel the better roads from Tôkiô to Odawara, Takasaki and Utsunomiya, and some heavy carts, no conveyances are to be seen on the Japanese roads.

The road has a varying width; is sometimes narrowed to a simple path, and at others ten or more meters broad. The crossing of the rivers is provided for by bridges and ferries, but at the time of long, heavy rains the road is often obstructed for days. The oldest and best known country roads of Japan are those which connect Kiôto with Tôkiô, the Tô-kai-dô, *i.e.* "East Sea Road," which passes along in the vicinity of the sea, and the Naka-sen-dô, "the street between the mountains," through the interior of Hondo. The former is 125 Ri long, the latter 132 Ri. There is also an Ôshiu-kai-dô, which leads from Tôkiô toward the north to Awomori, 191½ Ri distant, and the San-yo-dô, from Kiôto to Shimonoseki, which passes along the Inland Sea; and several others of those old country roads of the principal islands, upon which in former times

[1] 40 Kam-me (=150·26 kilograms) are counted a fair horse-load on a good even road, but upon the worst mountain paths only 18 Kam-me, or 67·62 kilograms. The load for a man is a weight of 7 Kam-me (=25·3 kilograms).

[2] Jin-riki-sha, *i.e.* "Man-power wagon," is a modern very popular vehicle, introduced into Japan some twenty years ago, and now as universal as the cabs of our cities. The Jin-riki-sha, or Kuruma (wagon), is a two-wheeled light cart with a seat over the axle, and a pair of shafts in which the Ninsoku, or man, places himself. He grasps the two poles, and then rushes forward at a rapid rate with his load of one or two persons.

the great Daimiô-processions travelled, and which in other ways afforded a regular commercial intercourse such as has been already described by E. Kaempfer.[1] The conifers, principally pines, which form the avenues along the roads, have been already (page 276) specially mentioned.

River navigation has many obstacles in Japan, as stated in vol. i. p. 89. Of course large river-systems could not be developed, but also many difficulties are placed in the way of navigation by the rapid fall of the upper courses of the great rivers, and the shallows of the lower parts, produced by shifting deposits of sand and other detritus. These difficulties can be only partly overcome.[2] Nevertheless, on many of the larger rivers traffic used to be very lively, and is so still to a certain extent, especially on the chief island; but this is due to the insufficiency of the roads and land conveyances. In this respect Kiushiu was especially ill-situated. Its industrial and commercial development was far behind that of Hondo during the Tokugawa Shôgunate (1600–1868 A.D.). Besides its ceramics, it had no notable industry. Silk culture was not practised at all, and tea raising with but little care. There were no good roads or means of communication in the interior, with the exception of those which several rivers (the Chikugo-gawa chiefly) afforded in the lower part of their courses. This is to be attributed partly to the mountainous character of the island; more, however, to the isolation of the country and the lack of co-operation between the several Daimiôs. A central power was lacking, for the Bakufu (the government of the Shôgun in Yeddo) either did not concern itself at all in these matters, or had an interest in preventing the co-operation of two powerful neighbours. It came to pass in this way that not only on Kiushiu, but also on the two neighbouring islands, the highways from one province to another remained in the worst possible condition; and it seemed better to make long roundabout journeys and long junk voyages at sea rather than give up the strained relations and the separation from one's nearest neighbour, and thus bring about the benefit of an easier intercourse.

The great sea expeditions which the Japanese had carried on in early times were placed under inextricable bonds by Iyeyasu at the beginning of the 17th century. For more than 250 years, up to the restoration of Mikado dynasty, Japanese navigation had been confined to the coasting service along its own shores, and, like its commerce in general, placed in a straight jacket, to throw off which required a foreign impulse. Commodore Perry accomplished in 1854, however, what the repeated efforts of English and Russians had not

[1] See also Rein: "Der Nakasendô," Erganzungsheft 59 zu Petermann's Mittheilungen.

[2] The rapidly changing depth of the rivers has even given rise to a proverbial expression: "Kinô-no-fuchi kiô-no se: Yesterday a deep place in the river, to-day a shallow."

succeeded in doing, viz., to peacefully wrest the country from its seclusion and bring it into friendly intercourse with the great seafaring powers.

At the time of the first landing of Mendez Pinto and his companions, in 1542, nothing excited the attention and amazement of the Japanese like the long firelocks which the explorers carried with them, and they soon succeeded in making them, and gunpowder also. So it was now. Commodore Perry impressed them much more by setting up a little telegraph line and a miniature railroad than by his stately squadron. These things aroused the greatest interest, and the desire to become possessed of them as a means of intercourse. It is no wonder then that, after the opening of commerce with Christian nations, and the overthrow of the Shôgunate, the building of steamboats and the establishment of telegraph lines and railroads became the first care of the new government under the Mikado. For the most influential adherents of the latter and protectors of his old rights against the Shôgunate, had, even before the decisive battles of 1868 (see vol. i. p. 357), laid aside their prejudice against the incoming barbarians, and recognised that only by accepting and carrying on all the newly introduced improvements on the new basis established by the Bakufu (Yeddo Government) could Japan become strong again and steadily develop. But it was not until the year 1870 that this new government, after overcoming the first great difficulties of the interior organization, entered on the most varied departments of business, and especially of open commerce, with a spirit of enterprise and reform, which to many of the lookers on seemed going too far, and awakened many fears as to the outcome. Fortunately, these fears have not been fulfilled. To-day, whoever glances without prejudice over what has been accomplished in the commercial life of Japan on land and water since that time, cannot withhold his admiration of the men who stood at the head of these enterprises. In other departments, especially in that of education, the reforms and their achievements have been no less important.

The establishment of an arsenal, and the erection of lighthouses and many other institutions for promoting navigation, went hand in hand with the foundation of the navy, begun by the Shôgunate. The arsenal at Yokosuka, south of Yokohama, was soon developed into a model institution and school for Japanese machinists under the long-continued careful direction of the Frenchman Verni and his associates. The Englishman Brunton directed the erection of lighthouses and other protective arrangements for navigation, so that fifteen years ago the most important or dangerous points along the coast had been provided with good signals, and the danger of commerce in Japanese waters greatly diminished. Japanese warships have undertaken many soundings, harbour measurements, and other labours, whose results have been made permanent in valuable charts, so that in this respect also the Hi-no-maru, or "Circle of the Sun," *i.e.* the national flag, with a red sun in a white field, need not hide its folds.

Enterprising merchants of Kôchi, the capital of Tosa, on Shikoku, with some considerable help from the government, established in 1874 the first Steamship Navigation Company, the Mitsu-bishi-guwai-sha, a name founded on its choice of a flag.[1] A second company, the Kiyodounyu-guwai-sha, was established some years later, and soon united with the first. The company is now called Nipon Yû-sen-guwai-sha, or "Japanese Post Steamship Company." Its boats have regular connection with all the important ports of the country, as well as with Shanghai, Fusan, Wönsan (Gensan), and Wladiwostok. They have a monopoly of Japanese coast navigation, and fifteen years ago had driven out the previous foreign competition on the lines of Yokohama, Kobe, Nagasaki and Shanghai.

In order to advance inland commerce four merchants founded, in 1872, the Nai-koku-tsû-un-guwai-sha or Inland Transportation Company, with a capital of 150,000 Yen or about £30,000. It has its chief office in Tôkio and its agents in every large town, forwarding not only merchandise and freight of all kinds, but money also, and has established a reliable, well organized service, as I was repeatedly able to observe. I know nothing of its present condition. The government decided in February, 1871, to undertake the entire postal service of the country. Two months later this was begun experimentally between the three capital cities, Tôkio, Kiôto and Ôsaka, and has been gradually developed and increased with the best success so far as the inland service is concerned, and now also with foreign countries. In 1879 the English and French post offices, which had existed up to that time, were superseded by the Japanese post office.

The first telegraph line of the country was built in January, 1870, between Tôkio and Yokohama. Others followed soon after, and the network which now binds all the larger towns of the empire together, and all with the capital city of Tôkio, grows constantly thicker and closer. Even in the use of the telegraph for weather reports to the Central Meteorological Office at the capital, the Japanese have followed the example of progressive Christian countries. A very special interest centres also in the development of the

Railroads, or Tetsu-dô.

At the close of the year 1885 Japan had the following railroads in operation :—

[1] This flag has three (Mitsu) red parallelograms in a white field, which are intended to represent the figure of a water nut (*Trapa bicornis*, Hishi or Bishi), which is said to be very common in Tosa. Guwai-sha=Kuwai-sha, pronounced Kaischa, is "company."

1. Tôkio-Yokohama	. . . .	7 Ri	11 Cho.
2. Hiôgo-Ôsaka-Kiôto-Ôtsu	. . .	24 „	
3. Nagahama-Tsuruga	. . . .	11 „	
4. Nagahama-Ôgaki	. . . .	23 „	
5. Tôkio-Takasaki	. . . .	25 „	20 Cho.
	In all	90 Ri	31 Cho.

or 356·84 kilometers. At present in process of construction :—

6. Takasaki-Ôgaki	275 km.

Besides which the following are projected :—

7. Ôsaka-Sakai	11 km.
8. Ôgaki-Yokkaichi.	53 „
8. Uyeda-Niigata	235 „
10. Tôkio-Awomori	705 „
11. Fukuoka-Kumamoto.	
12. Miike-Kumamoto.	

After the completion of No. 6, the principal line along the Naka-sen-dô from Yokohama to Hiogo *viâ* Tôkio, Takasaki, Uyeda, Ôgaki, Ôtsu, Kiôto and Ôsaka, will build branch lines to Sakai, Tsuruga, Yokkaichi and Niigata.

All the roads now in operation were built by English engineers commissioned by the government, and were provided with English rolling stock, but came then under administration and service of the Japanese, who proved themselves fully equal to their new tasks, so that no great accidents are reported up to this time. The first line, from Tôkio to Yokohama, was opened on the 12th of June, 1872. All classes of inhabitants were soon delighted with it and patronized it so extensively that a desire for the benefits of the new means of communication was excited in other parts of the country. The second road, from Ôsaka to Hiogo, was opened on the 11th of May, 1874, and in the following years was extended from Ôsaka to Kiôto, until on the 15th of July, 1880, the track from Kiôto to Ôtsu on Lake Biwa was added. Then followed railway lines from Nagahama to Tsuruga and Ôgaki, on which, as on the track from Kiôto to Ôtsu, pupils of the School of Engineers received their practical training, under English direction. The junction between Ôtsu and Nagahama was temporarily effected by steamboat, but the time seems not far distant when a railway will girdle the lake and supersede the steamer. Of a more recent date among the railroads at present in operation is the one from Tôkio to Takasaki, opened in May, 1884, by the Mikado. It is the first one planned, built and worked by the Japanese without foreign help. Although rolling stock is still imported from a foreign country (America), rails are now being manufactured or cast at Ikuno, near Kobe, and cars are being made in Tôkio. Surely this is much progress in a very short space of time. It is no wonder that they are moving about new enterprises in the same direction, and have planned a large number of projects whose execution may well be delayed for some time yet on account of the great expense.

3. The Foreign Trade of Japan up to the Time of the Opening of the Country under Commodore Perry in 1854.

a.—From the Discovery of the Country by Mendez Pinto in 1542 *to* 1639.

"The history of Japanese expeditions to foreign lands is yet to be written" is the observation of E. Satow, who remarks further that the materials for this work are widely scattered and must first be collected. It exceeds my power, as well as my purpose, to form such a collection, but it has seemed to me of interest, to group together here the most prominent dates which I have met with in reading the works quoted, as well as many others, regarding the foreign trade of the Japanese in former times, because they will show the change which has taken place here, as well as in many other departments, by comparing the ways and means of those days with the present foreign commerce. We see in this that the articles of export formerly of high value have either fallen back very largely or disappeared entirely, while others which were scarcely regarded at all thirty years ago now occupy the first place. Formerly the "marrow of the country," as Kaempfer expresses it, was its mining productions ; gold, silver and copper. In modern times agricultural products, such as silk, tea, and rice (the latter only in favourable years) exceed all the other numerous articles of export in importance.

In the first three decades of the 17th century the Dutch were able to drive out the Portuguese, Spanish, and English in the commerce with Japan, but they have been obliged to give way to the powerful competition of the larger commercial and industrial States since the time of the opening of the country thirty years ago. The trade of Holland declined far below that of most of the larger countries, England and North America at the head, to a point corresponding to the small extent of its own industry and its own consumption. The trade with Yokohama and Kobe was developed in a similar way at the expense of Nagasaki and Ôsaka.

There is a great lack of direct information concerning the old relations of Japan in trade with its Western neighbours, China and Corea, before the first landing of the Portuguese.

Hakata in Chikuzen appears to have been one of the Japanese ports from which a lively intercourse with China was maintained.

It is mentioned also in Taketori Monogatari, "The Maid from the Moon."[1] Ôsaka also, formerly called Naniwa, and Sakai, were important ports, having large commercial relations with China during the Middle Ages. Marco Polo does not mention this intercourse, nor does Barros in his work "Da Asia" make any statement of this kind; he does not once name the Japanese. On the other hand, according to Crawford,[2] in a commentary on Albuquerque, written by his son, according to information which the great Albuquerque received upon taking possession of Malacca in 1510, the Japanese (there called Goré) are said to have arrived every year with two or three ships. They were a silent, truth-loving people, who usually left their country in January and returned in August or September. Their wares were raw and prepared silk, brocade, porcelain, a great deal of wheat, copper, alum, and quantities of gold bearing the king's seal. The mention of silk and porcelain as export articles of Japan at that time, creates the suspicion that the writer perhaps confused the Japanese with the Coreans.

Evidences are not wanting that greatly feared pirates came from Japan, especially from the island of Kiushiu, who not only made the coasts of China unsafe, but extended their depredations to the Philippine Islands and the Malay Archipelago.[3] These occurred principally at a time when civil wars in Japan had desolated the country and relaxed all the restrictions of law and order, as for example, at the end of the 14th century (see vol. i. pp. 259, 260), and finally in the year 1600 A.D., before Iyeyasu had gathered the imperial power of the entire country in his own firm hands, and shortly after put an end not only to pirates, but also to the direct intercourse of Japan with other countries.

It is certainly remarkable that the three most notable sea voyages of great discovery in ancient times, were undertaken with the view of securing for Spain and Portugal the most valuable productions of Asiatic countries at the least expense. Columbus discovered America as he was endeavouring by sailing westward to reach the countries of Eastern Asia, especially the golden Zipangu (Japan) and Cathay (China), with its abundance of silks. For according to the descriptions of his countryman, Marco Polo, and Arab geographers, the former was the El Dorado of the Chinese and Arabs (see p. 295), while the latter has for ages enjoyed the reputation of a rich country because of its silk. Vasco de Gama led the Portuguese around South Africa to India, and thereby turned the previous trade with this productive, highly civilized country, into entirely different lines. Fernão de Magalhães, a

[1] Translated by R. Lange, 17 Heft der Mitth. d. d. Ges. Ostasiens.

[2] Crawford: "Descriptive Dict. of the Mal. Archipelago," p. 164.

[3] "The men of Japan have done much mischief unto the men of China, and many times fallen upon their coasts and put all to fire and sword."—The voyage of John Huyghen van Linschoten to the East Indies, p. 155. Hakluyt Soc., London, 1875.

countryman of Vasco de Gama, may be called the third prominent navigator of this period. He devoted himself, after the conquest of Malacca, out of spite towards his king, to the service of Charles V. (Charles I.), in order to furnish the Spaniards with the highly prized cloves of the Moluccas, while avoiding the Portuguese route. He accomplished in this effort, as is well known, the first circumnavigation of the globe, a few years after the Portuguese had sailed round tropical Asia, and obtained in Macao a new basis of operations for their trade.

Japan was finally discovered by the Portuguese, and the shipwreck which brought Mendez Pinto and his companions on its southern shore in 1542 A.D. was the beginning of a notable period for Japan, in which the spread of Christianity during the second half of the sixteenth century kept equal pace with an extremely profitable trade, with Nagasaki as its chief point. The trade of Japan with China also flourished in this period; for according to Thunberg some 200 Chinese ships arrived every year up to 1684, each with an average manning of fifty persons. They brought silk, silk handkerchiefs, sugar, turpentine, incense, agates, Baros camphor, ginseng and several other medicinal wares, besides medical books, taking away copper in bars, lacquer work, and other productions of Japan.

Portuguese trade between Goa, Malacca, Macao, and Nagasaki (or Hirado) was regulated by the monsoons and the king of Portugal. Linschoten states that the latter allowed but one ship to sail each year from Macao to Japan. This was a very large, good ship of 1,600 tons, the command of which for three years was given in reward for services rendered, as the captain made between 150,000 and 200,000 ducats on each voyage to Japan. He brought various wares from Macao, especially silks. The return trade was of silver and gold, which paid an immense profit, of 100 per cent. according to Kaempfer. Meijlan states that at the period when this Portuguese trade was at its highest point, the average annual value of this exportation of precious metals from Japan amounted to from eight to nine millions of Dutch gulden (£765,000). Thunberg, indeed, estimates it at the enormous quantity of 300 tons of gold, and remarks further, that even after the Portuguese had made themselves objects of hatred by their conduct in Nagasaki and elsewhere, and their trade had fallen into complete decadence, they still exported considerable quantities of silver—thus in 1636 A.D. 2,360 chests or 2,350,000 Japanese taels at 2*s.* 9*d.*, in 1637 A.D. 2,142,365 taels, and in 1638 A.D. 1,259,023 taels.[1]

With this, as is well known, the trade of the Portuguese in Japan came to an end; for their complete exclusion soon followed (1639), and when in 1640 they had again separated from Spain and attained their former independence, they saw themselves robbed of their profitable commerce and rich possessions in Asia, down to a few

[1] A Japanese tael is reckoned at 33 stiver=1·65 Dutch florins=2*s.* 9½*d.*

inconsiderable remnants. Several attempts that were made from Macao to regain the commercial ground lost in Japan met only with the greatest misfortune. Their former paradise remained closed to them.

After the union of Portugal with Spain, through Philip II., in 1580 A.D., an occurrence from which the Portuguese date the decline and eventual loss of their commanding position and of their considerable Asiatic commerce, Manila was also included in this deprivation. The commerce of this city with Macao and Japan, in regard to which the work of A. de Morga cited above gives interesting information, was very active.

Towards the end of October and during March the ships used to sail with northerly winds from Nagasaki to Manila. They brought to the Philippines chiefly flour of very good quality, and also much valued salt meat, salt tunny-fish, very good (?) fresh pears, iron tools and weapons, among them fine swords, besides beautiful screens, artistically lacquered jewel cases of rare woods, and other trifles attractive and handsome,—cages, a little silver, patterned silks. There were also horses from Japan, of which de Morga gives an excellent description. The ships returned to Nagasaki in June or July, under the influence of the southern monsoon winds; their freight from Manila consisted of raw silk (from China), hartshorn-shavings (?) and brazil-wood for dyeing, honey, wax, wine (from Spain), Thibetian cats, great jars (Tibór) for keeping tea, and also glass and clothing material.

The first disturbance of these amicable relations was made by "Taiko-sama, the Lord of all Japan," in a letter to the Governor,[1] wherein he arrogantly ordered him to recognise his superior rank and to send tribute in recognition of it, or he would come with a fleet and destroy the land. The tone of this letter corresponds exactly to that in which Hideyoshi addressed the king of Corea when he desired him to enter into an alliance against China (see vol. i. p. 282). The correspondence lasted several years according to de Morga, and then Taiko-sama died. From this it is seen that this insolent letter must have been written about the year 1595.[2] It occasioned great anxiety in Manila. Through fear of an invasion all the Japanese, who were there in considerable number, were sent back to their country.

In the year 1596 Don Francisco Tello, the new governor of the Philippines, came into office. One year later the ship San Felipe,

[1] Gomez Perez Dasmariñas, who had arrived at his post in 1590, by the route then common—via Acapulco.

[2] According to Dutch sources ("Mémorables Embassies," etc.), Taiko-sama had stated in this document that the civil wars in Japan were over, and that he himself was a pledge of internal peace. He now wished to make war upon China, and desired to this end the good-will of the governors, as signs of this demanding subjection and tribute. From this we might conclude that the state paper dates from the year 1591, as the expedition to Corea, for the above-mentioned purpose, took place in 1592.

which had been driven out of its course by contrary winds on a voyage from Manila to New Spain (Mexico), touched at the coast of Tosa on the island Shikoku. The head quartermaster, Francisco de Landa, declared to the confidential adviser and plenipotentiary of Taiko-sama[1] that Spain was conquering the world, with the help of Spanish priests. This contributed not a little to the increasing aversion of the governing classes to Christianity, a feeling which soon resulted in the bloody persecution of its missionaries, and later in its complete extirpation.

Iyeyasu[2] was at that time still inclined to trade with the Spanish and Portuguese, even going so far as to negotiate with Father Geronymo (who had concealed himself during the first persecution of the Christians by Taiko-sama in 1597) for the importation of Spanish carpenters from Manila to build ships, in order that he himself might establish direct commercial relations with New Spain. Chiquiro (?), the ambassador of Iyeyasu, who carried his presents and good wishes with letters of Father Geronymo to the Governor of the Philippines, found a friendly enough reception, but did not obtain the desired ship carpenters, because the Japanese were not wanted as competitors for the trade of Nueva España.

In vain did Iyeyasu and Geronymo wait for the vessel's return. It had been wrecked on the coast of Formosa and sank with all on board. Later Fray Geronymo himself went to Manila, returning thence in 1601 with excuses and gifts for Iyeyasu. These gifts were a large, richly decorated mirror and other glass-wares, Castilian cloths, honey, several large Chinese porcelain jars, and Spanish Tibór, or vases and jars of Faïence.

Meanwhile Iyeyasu had succeeded to the Shôgunate, with practical supremacy over the whole of Japan. The struggles of the year 1600, in which he overcame his adversaries, had tempted the coast population of Kiushiu once more to piracy. Not less than six corsair ships had sailed out from Satsuma to ravage the coasts of China and the Philippines. Upon the complaints of the governor of Manila, Iyeyasu promised assistance, demanding, however, in return, that fugitive Japanese should not receive protection, and still less assistance in effecting secret landings on Japanese coasts. It seems, however, that this wish was not fulfilled. With reference to this, as in many another respect, peculiar interest attaches to a letter of the mighty Shôgun to the Governor Don Pedro de Acuña in the year 1605. In it Iyeyasu first thanks the governor for his presents, of which the wine especially had given him great pleasure. But then he begs the governor to hinder fugitive Japanese from

[1] He is called Ximonojo, Yemonojo, and Gibunoxâ. He seems to have been Ishida Mitsunari, one of the later five governors. (See vol. i. p. 494.)

[2] "Yeyasu dono, Lord of Quanto," as he is called in the English translation of the book by A. de Morga, p. 143. Compare vol. i. pp. 11, 282, and p. 311 of this work.

finding support in Manila and returning to Japan with Spanish ships without his (Iyeyasu's) permission. To the numerous representations with respect to the Christian sect which the governor and others had made to him, he could not agree. "It is in no wise agreeable to our best interests that your faith be preached and disseminated in Japan, and if your Highness desires to maintain friendship with the rulers of Japan and with me, I beg you to agree to my wishes and to do nothing displeasing to me." It is plainly seen from this energetic language that Iyeyasu was already firmly determined to strenuously oppose the spread of Christianity. Only once, as is seen in what follows, do we find him friendly disposed towards Christianity, but this might have been expected from his earlier expressions.

In the year 1608—the "Memorials of the Empire of Japan" tell us, according to Th. Rundall—the ship was wrecked in which the Governor General of the Philippines, Rodrigo de Vivero y Velasco, was returning from Manila to Spain, via Acapulco. This was on the east coast of Hondo, in latitude $35\frac{1}{2}°$ N. The crew and Don Rodrigo saved only their lives, but were hospitably received by the Japanese, and provided with every necessity. The Governor General in particular received on all sides a great friendliness corresponding to his rank, especially at the court in Yeddo, and also at Shidzuoka in Suruga, whither Iyeyasu had withdrawn in 1605, although still retaining the guidance of national affairs.

Everything was restored to the Spaniards that could be saved from the wreck, although according to law and custom the Japanese government possessed full jurisdiction over stranded goods. In Shidzuoka Don Rodrigo laid three requests before the ex-Shôgun, viz. :—

1. That Iyeyasu would extend his protection to foreign priests and their missions.

2. That he would continue in maintaining friendly relations with the king of Spain.

3. That he would forbid the Dutch, being rebels and pirates, to sojourn in his country.

Iyeyasu expressed to Don Rodrigo his satisfaction that, although stripped of all his possessions, he had sought nothing for himself, but everything for his king and his religion. He was prepared to grant the first two petitions, not the third, having pledged his word to the Dutch and allowed them to trade in his country under the same conditions as other foreigners.

Iyeyasu requested from the king of Spain, through Don Rodrigo, fifty miners experienced in the silver mining of New Spain, his own being unable to extract half the precious metal existing in the mines. He dismissed him in the friendliest manner. The object of Don Rodrigo's next journey was "Meako" (Kiôto), where the governor, by order of his master, made him acquainted with everything worthy of notice. Thus Don Rodrigo saw among other things the Daibutsu, of which he remarks that it should be reckoned among the wonders of the world. From Kiôto he betook himself by way of Fushimi to Ôsaka, and then in a boat to Nagasaki. But the ship which was to have brought him back to Manila not being ready, he returned to Suruga and did not leave Japan until August, 1610, departing with rich gifts. Hence he had full knowledge of the landing of the Dutch on Hirado,[1] and their entrance into the competition, which was soon so fateful for the Portuguese and Spanish, as well as for the Catholic Japanese.

The trade between Japan and the Philippines lasted over fifty years, from 1580. During this time Japanese enterprise developed itself also in other directions. Japanese seamen not only took service on foreign ships and made long journeys in them, but, in conjunction with merchants, fitted out junks themselves. At times they ran in friendly commerce along the coasts of China and Farther India, and again as bold corsairs they preyed upon trade in these parts.

In the above-mentioned memoir by E. Satow, on the trade between Japan and Siam, we perceive how active it was in the first three decades of the 17th century. In Ayuthia, at that time the capital of Siam, and in Patani, the most important commercial point on the Gulf of Siam, there was a Japanese colony, which sometimes played a part even in politics. The first three Shôguns maintained direct friendly commercial relations with the king of Siam for twenty-four years. Both courts repeatedly interchanged letters and presents, these being in several cases conveyed by Siamese embassies. Iyeyasu began these direct relations in 1606, sending to the King of Siam a letter, with several swords and suits of armour, and begging from him a few muskets and some fragrant calambac (*Santalinum album*, L.). We discover from the correspondence which followed that the King of Siam and his first minister repeatedly sent such white sandalwood, besides Borneo camphor, elephant tusks, and costly silks, as presents for the Shôgun and his chief dignitaries, not to mention various European products, such as sarsenet, calico, gauze, and other fabrics, besides muskets and powder. The Japanese gifts in return were in particular horses with costly saddles, weapons and suits of mail, beautiful screens, festival garments of wadded silk, bleached cotton stuffs, and silver.

With the year 1630 this official intercourse suddenly ceased. In Ayuthia, Phra-Chao Phrasa-thong had taken possession of the throne, and when he thereupon, following the example of his predecessor, sent an embassy to Japan with letters and presents, these were refused. The same happened to several other Siamese embassies which followed. But even after 1636, when the Japanese

[1] The city and island of Hirado, generally called Firado, Firato, and Firando in older writings, lie on the west side of Kiushiu, and belong to the province of Hizen. (See vol. i. p. 523.)

were forbidden by law to leave the country and to trade with foreigners, commercial relations with Siam did not fully cease. The Chinese, to whom, with the Dutch, trade with Nagasaki was permitted, became the middlemen. Siamese junks, as Satow states, following Japanese authorities, came in six different cases, viz., in the years 1680, 1687, 1693, 1716, 1718, and 1745, though with what success is not said. Before the closing up of Japan under the third Shôgun (Iyemitsu) Siamese ships brought away gold and silver, copper in small bars, goldsmiths' work, umbrellas and parasols, lacquer wares, porcelain and tea.

The various occurrences that led to the closing up of Japan and the extirpation of Christianity were dealt with in detail in vol. i. of this work. From the short account here given of the relations of the Shôgunate to the Spaniards in Manila and to the Siamese, it is evident that these measures are not to be looked upon as immediate consequences of the battle of Sekijahara in the year 1600, but that the political and religious motives in which they originated were only of gradual growth. The conclusion of commercial relations with the Dutch and English had great influence upon this change in opinion and feelings. These powers at the beginning of the 17th century extended their struggles against Catholic Spain and therewith annexed Portugal, even to the distant stations of the world's market, and with success.

The struggles of the Protestant Dutch for their civil and religious liberty had fostered in them an irreconcileable enmity against the Spaniards and Roman Catholicism, had developed their courage and enterprise, and prepared them for further deeds of prowess. Scarcely had they thrown off the Spanish yoke when Dutch ships, impelled by commercial interests, cruised through every sea. In Amsterdam the nautical school of Peter Plancius gave the incipient seafarer a better education, and the atlas of L. J. Waghenaer of Leyden furnished him with more reliable maps. Thus the general demand received effective support,—the demand to become wholly independent of Spain even in commerce, now that her power was enlarged by the addition of Portugal and its colonies. Narrow-minded decrees of Philip II. of Spain closing Lisbon, the former world-market, to the Dutch, did the rest. The enterprises of the Dutch led to important geographical discoveries—I mention only those of Barents and Tasman—as well as to their acquisition of most of the Portuguese possessions, with their Asiatic trade.

Upon the first Dutch circumnavigation of the globe (in the years 1598–1601) under Oliver van Noort, who followed the route of Magelhães and inflicted heavy losses on the Spanish in a sea fight off Manila, there followed, in 1602, the establishment of the Dutch East India Company. Batavia became its chief point of support and of the trade it carried on in South-eastern Asia, while Goa, Malacca, and Macao lost their commercial significance. In April of the year 1600 the Dutch flag appeared for the first time on the Japanese coast, at Funai, in Bungo. The ship that carried it had, with four others, formed a small commercial flotilla of the Dutch house van der Veek, which had left the harbour of Texel in June, 1598, to carry on trade on the Pacific coast of South America. The expedition was sent out too late in the year, and suffered great losses in consequence of bad steering, heavy storms, and hostile attacks, so that at last only one ship, the Erasmus, remained, with but a small crew. They directed her course from the Peruvian coast to Japan, in the hope of finding there a market for her cargo of cloths. When they landed in Funai, only five men were fit for duty, among them William Adams, an Englishman and first-mate of the Erasmus. These and the sick as well were given a friendly reception by the native population, though represented as pirates by the Portuguese. The latter contrived to have Adams sent as a prisoner to Iyeyasu, who was then in Ôsaka. Iyeyasu received him kindly, questioned him, and sent him to Yedo, where he was set at liberty, and lived for the most part till his death, in 1620. William Adams won a position of respect among the Japanese, serving at first the interests of the Dutch, and later of the English; and he probably contributed towards feeding the feeling of envy towards the Catholic Spaniards and Portuguese, and bringing about the well-known crisis (see vol. i. p. 330 ff.).

In June, 1609, the Dutch ship Roode Loeuw (Red Lion) appeared in the harbour of Hirado, and was hospitably received by the Daimiô of the island. In the following year, Jacques Spexx (Jacob Spex), the commercial representative of the Dutch East India Company, and M. Sandvoort, betook themselves to Suruga, to negotiate a commercial treaty with Iyeyasu, and then to Yedo, to treat with his son, the Shôgun. William Adams acted as interpreter. The Dutch obtained permission to erect a factory in Hirado, and to trade with Japan under similar conditions to the Portuguese and Spaniards in Nagasaki. The latter had done all they could to keep away the incoming heretics, whom they represented to Iyeyasu as sea-robbers, and rebels against their lord, the King of Spain—men to whom he could not possibly lend attention. But the wise and mighty prince had no intention of letting slip the opportunity of encouraging a competing foreign influence. He answered, in effect, that European affairs did not concern him, and that he was mindful only of the peace and welfare of his own land and people. Every foreigner who obeyed the laws and would trade honestly, and to the advantage of his subjects, was welcome; "yea, even if devils came from hell, they should be treated like angels from heaven," as long as they heartily submitted to the rules he had established.

Induced by letters from William Adams, the English East India Company soon thereafter determined to enter into trade with Japan. To this end they sent three ships under the command of Captain John Saris, which cast anchor before Hirado, on the 11th of June, 1613. The old Daimiô appreciated the commercial advantages which the foreigners brought to this little island, and received the English kindly. After Adams had joined them and Captain Saris had rented a house to be used as a factory, the latter, with Adams to interpret, and the necessary credentials, and presents from King James I., departed for the court in a boat which the Daimiô placed at his disposal. The embassy was amicably received both by Iyeyasu in Sumpu (Shidzuoka), and by his son, Hidetada, the reigning Shôgun in Yedo. After brief negotiations, conducted by Adams, who was favourably known at court, it secured a general commercial privilege. This was, however, by an amendment of the year 1616, restricted to Hirado, like that of the Dutch. Richard Cocks acted as director of the factory, from its establishment to the dissolution, which the company ordered in 1623. A competition of ten years with the Dutch had cost it a total loss of over £40,000. But even though the commercial enterprises of the English in Japan were unsuccessful, they departed with honour from a well-contested field. They had made the attempt at a very unfavourable time and an unsuitable place, a small, non-productive island, in direct competition with the Dutch, and with the Portuguese and Spaniards, who still retained great influence in Nagasaki. Their hope that the Chinese market would open to them was not fulfilled, and in Japan the Dutch possessed more experience and practice. These scorned no means of crowding the English out, even selling many of their wares below cost, as, for example, cloths manufactured in England. Their conduct, as Cocks in many parts of his journal remarks, was unendurable, even when, by higher command, the English took sides with them against Spaniards and Portuguese. For such extraordinary difficulties the intelligence and activity of the director Richard Cocks were insufficient. It is easily seen from his tedious journal that he was uneducated, weak, and slow, though good-natured and honest enough ; and that there must have been great disorder in his conduct of business. All this we learn, too, from the bitter censure with which his "loving friends" and superiors at Batavia recalled him in May, 1623. Subsequently the Dutch were successful in frustrating all attempts of the English, as well as of other nations, to renew commercial relations with Japan. Stories about the over-crowding of the market with imported goods, and a fall in prices, remind one of many an occurrence in the Japanese trade of modern times, except that formerly it was not customary to sell at public auction. White raw-silk from China and Siam, which used to be sold in Nagasaki and Hirado for 500, 400, and 300 Ts. (Taels at 6 shillings), were offered at 130 Ts. in the year 1620. The market was as much flooded viâ Patani with Siamese velvet and flowered silks, red and white sandal-wood, deer-skins, and ivory, as with Spanish cloths, imported from New Spain (Mexico), and English, brought by Dutch and English vessels.

Cotton stuffs were less in demand, and so were spices. In these articles also, the supply far exceeded the demand, and so it did in the case of steel, tin, and lead, mirrors, Danzig bottle-glass, amber, patterned linen, and plain Dutch linen. Of the rich exportation of metal (gold, silver, and copper), only a very modest share seems to have passed through English hands.

It is easy to see from Cocks' journal how the difficulties and limitations of Japanese foreign commerce grew with the increasing hostility towards Christianity during the reign of the Shôgun Hidetada. The Shôgun Iyemitsu, the energetic grandson of Iyeyasu, had scarce grasped the reins of government, in 1623, when the last great outburst against foreigners occurred. Spaniards and Portuguese were banished from the country; the Christians were persecuted, tortured, and slain; Japanese subjects were forbidden on pain of death to leave the land, and commerce was restricted to the Dutch and Chinese. Herewith begins a new period in the trade with Japan, namely:

b.—The time of trade with the Dutch and Chinese in Nagasaki, from 1641–1854.

When the English had withdrawn from the Japanese market, and the trade of the Iberian Catholics had been destroyed with those last annihilating blows at Christianity which were described in vol. i. pp. 304–311, the Dutch found themselves alone, masters of the field indeed, but in no enviable position among the Japanese. Obedient to the Shôgun's decree of May 11, 1641, to give up immediately their factory at Hirado and remove to the little, artificial island (De-shima) formerly intended for the Portuguese, close to Nagasaki, they made the change ten days later.

It was with unclean hands that the Dutch took possession of De-shima. Excluding all criticism except from their own side, and disregarding the prejudiced opinions of the Jesuits, and judging many of their actions in the spirit of that age, and with an understanding of the mutual enmity and calumniation between them and the Iberian Catholics—making all these allowances, one still cannot acquit them of complicity in those frightful massacres through which Christianity was extirpated in Japan. Nor can we refrain from the no less heavy charge that they denied their own religion in Nagasaki and sacrificed their honour in order to retain a profitable trade. They proclaimed their subjection to the will of the Japanese and humbled themselves before them on so many occasions, that these—accustomed to regard their own commercial classes rather as a necessary evil, and to put them after the farmer and artisan, like the old Romans—could not but form a bad opinion of their character and their sense of honour.

On De-shima lived sixteen to twenty Dutchmen in the East India Company's service, restricted in their movements, and watched like prisoners. In regard to their position, Kaempfer writes as follows:

"In this servile spirit we have had to put up with many insulting restrictions from these haughty heathens. We dare not celebrate any Sunday or feast-day, we dare not be heard in hymn or prayer, nor name the name of Christ, nor possess any representation of the cross or any other outward mark of Christianity. Moreover we have to endure many other insolent assumptions, against which a noble heart always rebels. The single reason that induces the Dutch to endure all these ills so patiently is merely love of gain and of the rich marrow of the Japanese mountains." [1]

Beginning at page 97 of his work here cited, Kaempfer gives a detailed description of the way in which this trade in Nagasaki was regulated, down to the smallest minutiæ, and controlled by a crowd of officials. Direct expenditures did not depend on these rules, but presents to those officials and to the court, which the Opperhoofd, or director of the factory, had to take every spring at his presentation in Yedo, swallowed up a great part of their profits, which were considerable.

"No sooner had our ships reached the harbour than they were taken possession of by the Japanese and surrounded by police-boats; powder, lead, swords, and all the paraphernalia of the vessel were carried ashore and guarded until its departure. Even the heaviest cannon and the rudder itself had to be taken out and brought to land; but later they gave this up, on account of the great and unnecessary labour involved. At the same time, immediately on arrival all persons on board were carefully scrutinized, according to a list they had to furnish, and the name, age, and duties of each were written down. Those who went to the island on business were examined with great exactness, being relieved of their swords and all saleable objects by the Ottona; [2] and without permission and escort from the Japanese absolutely no one dared approach or depart from the ship, which usually lay at anchor about 300 paces from the island. The goods we brought with us were taken by their servants to our own warehouses and put away under their seals." Nevertheless Kaempfer speaks in another place of a "hitherto perfectly free trade," which was not "remarkably restricted" till 1672. The new limitation was that a specimen of every kind of imported goods had to be taken to the governor's house to be inspected and taxed by experts. Then the merchants came and selected what they needed. If the Dutchmen were not contented with the price fixed by the governor, they could keep the goods.

The Chinese enjoyed much greater liberties. They were allowed to live in Nagasaki, were less watched and hemmed in their movements, required no director of trade, and did not have to send

[1] Kaempfer's "Geschichte von Japan," vol. ii. p. 72.

[2] Ottona means in old writings the plenipotentiary, a sort of police commissary.

embassies and presents to the court. They paid no taxes either, but were, like the Dutch, compelled to hand over their goods at a price fixed by the "Chamber of Çommerce of the Shôgun." They brought much more merchandize than the Dutch ; but we have only estimates of its total value. Up to the year 1684 there came, according to Thunberg, 200 Chinese junks annually to Nagasaki, each with a crew of 50 men. From thence, the number fell away to 70 and the crews to 30 men apiece. According to the same source, their imports had a total value of only 600,000 Taels (= about £180,000) annually. They consisted chiefly in raw silk and silken cloths, besides sugar, turpentine, myrrh, aloe-wood,[1] Baros camphor, ginseng, and other drugs, and medical books. In addition to these there were various other products of their industry, such as porcelain, soap-stone, goat-skins, and other things, some of which they sold to the Dutch. In this list the reader will perceive that part of the drugs came from tropical Asia.

In the first period of the Dutch trade with Japan (1611–1641), *i.e.* as long as its centre was the factory at Hirado, it never suffered any considerable falling off, either in the number of ships that arrived, or otherwise. This was its most flourishing and profitable era, despite the low prices of many imported articles occasioned by competition. The total value of exported precious metals, copper, and camphor, the most profitable articles in those thirty years, is estimated at £15,000,000. This agrees with Thunberg's figures, who places the yearly export trade of the Dutch at 6,000,000 gulden (£510,000). Of this, 4,000,000 fl. (£390,000) are for silver alone. The transition year, 1641, was still very favourable to the Dutch trade. The Dutch sold wares worth 80 tons of gold, besides exporting 1,400 chests of silver, each containing 1 Pikul (60 kg.).

The Dutch, and also Kaempfer and others, call the time of their monopoly in Nagasaki, 1641–1859, the second period. In the early part of it, the Dutch could still regulate prices, and made great profits. But in 1672, that ceased to be the case, as has been said. Hence Kaempfer, with much discrimination, says in reference to this year and the poor ones that followed : "Our golden fleece, which we carried off annually from this Colchis, changed into an ordinary skin." Nevertheless, the profit on imported wares, after deducting all costs, was still 40–45 per cent., and that on the copper taken in exchange was just as great. It formerly amounted to 90–95 per cent. The annual exportation of this metal, which for a while (1637–1646) was forbidden, amounted to 20,000 to 25,000 Pikul (24–30,000 cwt.).

From the year 1640 forward, coined gold was again allowed to be exported. In the course of two years, 100,000 pieces of Koban

[1] Aloe-wood, Jap. Kiyara, named after a Sanskrit word, came from India and Siam ; the Dutch and Portuguese called it Calumbak and Kalambak. It is the fragrant wood of *Aloexylon Aquilaria*, Roxb.

were exported, on which a profit of 1,000,000 fl. was realised. In 1671, the exportation of silver was prohibited, but that did not much concern the Dutch, as it brought them little gain, and the exportation of copper seemed all the more considerable. In fact it rose to 30,000 Pikul, a height that it has never reached again. In 1696, it was limited to 25,000 Pikul; but, as Meijlan states, they managed to get 6–7,000 Pikul more by bribery. The greatest part of this copper was still brought to India, as in the time of the Portuguese.

The trade suffered further noteworthy restrictions from the year 1700, in which it was decreed that only four or five Dutch ships should come to Nagasaki annually. In 1714, the exportation of copper was reduced to 1,500 Pikul, and in 1717 the entire Dutch trade was limited to two ships. In 1721 the Japanese fixed the exportation of copper at 10,000 Pikul, but reduced it again, in 1743, to 5–6,000 Pikul. In this year it was also decreed that for the future only one ship should come to Nagasaki annually, though in 1759 the law was changed, and three ships annually were allowed.

According to a statement of the Opperhoofd of the year 1760, the total yield of the country in copper amounted to 36–40,000 Pikul (44,000 to 48,000 cwt.), of which the Netherlanders exported 11,000 Pikul, the Japanese governors and officials in Nagasaki received 900 Pikul, the Chinese 15,000 Pikul, and 10,000 to 13,000 covered the domestic demand. This increase of exportation to 11,000 Pikul, however, did not take place till 1820, after a period of ten years, during which only an annual exportation of 8,000 Pikul had been allowed. It would lead us too far to mention here all the other vicissitudes and restrictions which the Dutch trade suffered in the course of that long period, or to mention the figures which represent its total value. More interesting, perhaps, will be, in conclusion, a brief glance at the various wares with which it was concerned.

The most notable import and export articles of Japan during the great commercial movement in the first decades of the 17th century have been already mentioned. Thunberg's lists refer to a much later period, namely the last decades of the 18th century.[1] According to these, the Dutch imported to Nagasaki, raw silk, silken and half-silken fabrics, cottons and wools, cordovan, raw sugar, and spices, such as ginger, pepper, saffron, cloves, nutmegs, drugs, especially turpentine, Baros camphor, musk, benzoin-gum, storax, myrrh, catechu, China-root,[2] costus Arabicus,[3] licorice,

[1] "Resa," etc., vol. iii. pp. 47, 48, and vol. iv. p. 106.

[2] China-root (*Smilax China*, L.), the oriental small-pox, or sweat-root, viz., the rhizoma of a scrambling under-shrub which also grows wild in Japan. It was brought from India, and is also called Chinese Sarsaparilla.

[3] This is the root of a composite from India, whose botanical name is *Aplotaxis auriculata*, D.C.

amber, calumbak,[1] Lignum colubrinum,[2] gum lac, sapan-wood, saltpetre, borax, alum, ivory, narwhal tusks (of Monodon monoceros, L.), buffalo horns, ray-skin, corals, tortoise-shell, glass, glass-eyes, files, nails, bar-iron, lead, tin, quicksilver.

The silk came from China, Tonquin, Siam, Bengal and Persia; sapan-wood, buffalo horns, and ray-skins (shark-skins), stag and buffalo skins were brought from Siam and Cambodia; pepper and sugar from India and Persia; most of the spices from India and the Moluccas; Cordovan or Spanish leather, from India and Persia; the Baros camphor from Sumatra.

Besides the company's trade, the captain and crew were permitted to exchange saffron, licorice-root, rattan, glass-eyes, looking-glasses, clocks, tusks, and certain other articles. And through the crew various rarities came into the land, such as living parrots, trained monkeys, shells, etc.

As the most notable export articles, Thunberg mentions copper and camphor, and then, secondarily, lacquer-wares, porcelain, silk cloths, rice, saké and soy. This last was more highly prized than the Chinese. It was carried to Batavia, the East Indies and Europe. On the other hand, porcelain (the Tsubo or covered jars are here mostly meant) was in Thunberg's opinion far behind that of China in beauty, being thick, awkward and not well-painted. The shining sticks of copper, of the thickness of a finger, were packed in chests, each holding one Pikul, or 60 kg. Each ship carried off 6–7,000 of these chests.

4. Japan in the Commerce of the World.

The commercial monopoly of the Dutch had gradually lost most of its former significance for the parties concerned, being now as much out of date as was the governmental system of the Shôguns of the Tokugawa house, a dynasty founded on terror. It only needed an energetic impulse from without to put an end to both and effect a thorough change in the state of things. The United States expedition under Commodore Perry, in 1854, brought this impulse. It was the yeast which set the educated class of the Japanese nation fermenting from one end to the other of their long string of islands—a fermentation which culminated in the downfall of the Shôgunate and the re-establishment of the Mikado's power in 1868. How this restoration came to pass, and what struggles and rectifications the new rule had to experience before it could be considered to be the firm basis of a new era in commercial and social life, was narrated in detail in pp. 339–382 of vol. i. It only

[1] Calumbak, Columbac, or Columbak is said to be a corruption of the word Colombo. The name was given to the aromatic eagle-wood (*Aquilaria Agallocha*, Roxb.; *vide* note, p. 526).

[2] Snake-wood (*Strychnos colubrina*, L.).

remains to recount briefly the development of foreign commerce that has taken place under this new system.

According to the "Treaty of Kanagawa," which Commodore Perry concluded with the government of the Shôgun, March 31, 1854, in the name of the United States of America, and which was put in force the following spring, the ports Shimoda in Idzu and Hakodate on Yezo, were to be open to trade with North American ships. But Shimoda soon proved unsuitable, and Hakodate too far from the centre of national life to serve the chief purpose of the treaty, so that Consul-General Harris insisted on its revision, and at last successfully.

The American pioneers were soon followed by the Russians, French, and English, and in 1860 by Prussians, Dutch, and other nations. They secured the same rights. The treaties were concluded with the government of the Shôgun in Yedo, at a time when its relation to the Mikado in Kiôto was not clearly known, but in 1865 they were confirmed by him. Their principal provisions are as follows :—

1. Diplomatic agents of the governments concerned obtain the right to dwell in Yedo, are under the protection of the Shôgun, and may travel in the country unmolested.

2. The treaty-powers may also establish consulates in the ports open to commerce.

3. Kanagawa (Yokohama), Nagasaki, and Hakodate are opened on July 1st, 1859, Niigata, 1860; Hiogo (Kobe) and Ôsaka, 1863.

4. In each of these places a fixed territory is given over to foreigners, upon which they may build, after paying a regulation tax.

5. These districts remain under the jurisdiction of their own consular officials.

6. They enjoy freedom of religion and trade; the latter, however, only with the payment of a fixed tariff of 5 per cent. of the value of exported and imported goods.

7. The foreigners have freedom of locomotion within a circle of 10 Ri from the settlement, but must have special permission (which was always most willingly accorded for scientific and sanitary purposes) to cross the treaty-limits.

Kanagawa, after which the treaties were named, and whose name still appears in English consular reports, was soon exchanged for Yokohama, hard by. Here the deep, spacious, and accessible bay, with its good anchorage, offered far more favourable conditions for shipping, while the nearness of the capital, Tôkio, and of the principal silk and tea districts, afford greater advantages to commerce than any of the other harbours. Under these circumstances the fishing village Yokohama developed rapidly into a large city, numbering now about 80,000 inhabitants. The foreign colony at its side, a city by itself, with gas and all other European comforts, contained 4,000 souls in 1883, including 2,681 Chinese, with 180 firms; 595 English, with 55 firms; 253 North Americans, with 27 firms; 160 Germans, with 22 firms; and 109 French, with 15 firms. In that year there arrived 313 foreign vessels, with 556,024 tons of cargo; and 319 vessels sailed with 560,756 tons. Since that summer the German mail steamers of the Bremen Lloyd have been running, in addition to the English, French, and North American mail steamers, which have long been in regular service with Yokohama from Southampton, Marseilles, and San Francisco, contributing largely to the advancement of commerce with their respective countries. It is to be hoped that in the case of the German line the saying of the well-known Englishman, Forster, may prove true: "Trade always follows the flag."

The business of Yokohama has increased continuously, if not steadily. It amounted to:—

	Vessels.	Tons.	Exports.[1]	Imports.
1865.	168	74,088	17,467,728 yen.	5,443,594 yen.
1875.	330	435,613	12,466,730 „	21,953,909 „
1885.	364	495,772	23,850,398 „	18,630,379 „

From Table I. it is seen that during the last five years (1881 to 1885) the foreign commerce in the four treaty-ports which are there taken account of is divided as follows, in per-centage:—

	Yokohama.	*Kobe-Ôsaka.*	*Nagasaki.*	*Hakodate.*
Exports	69 per cent.	20 per cent.	9·3 per cent.	1·7 per cent.
Imports	67·5 „	28·8 „	3·4 „	0·3 „

Yokohama exports almost all the silk, the greater part of the tea, next to Kobe the most copper, a considerable part of the fishery products, and most of the works of industrial art.

Kobe-Ôsaka.—Kiôto was for over 1050 years the heart of Japan, whence proceeded the pulsations of national life. Ôsaka, however, was a great antechamber, at least for the material side of this life. The establishment by the Tokugawa of a second business centre in Yedo did little to change this relation. By its central position, its proximity to Kiôto, its accessibility by land and water, Ôsaka was peculiarly adapted to be an emporium of the domestic trade of Japan. Indeed it still plays this part to a certain extent, especially in the rice business, although, since the opening of the country, the overthrow of the feudal system, and the removal of the imperial residence to Tôkio (Yedo), it has lost considerably. Most of the Toiyas, or wholesale dealers, often with great businesses and store-houses, were at Ôsaka. Here each Daimiô had his Kura-yashiki, or official business-house, which represented him and attended to his business. The same was the case in Kiôto.

[1] The large sum for exports in 1865, in connection with the small tonnage, is explained by the enormously advanced price of silk at that time.

With business proper there developed a lively money-business, or banking. Ôsaka possessed not only the greatest and richest dealers in rice, tea, and silk, but also the most banking-houses. On account of the shallowness of its harbour, it is almost as ill-suited for direct foreign commerce as Tôkio. Just as Yokohama, with its excellent harbour, is reached from Tôkio by one hour's railway journey, so Kiôta and Ôsaka have near them Kobe (Hiogo) for their foreign commerce by water and rail—a place whose foreign business has largely increased.

The exchanges of Ôsaka in direct trade with foreign countries are about one-seventh as much as those of Kobe, and are made mostly in native and Chinese junks. Kobe is the foreign settlement, a new city, close to Hiogo, beautifully situated on the Inland Sea. Its harbour is commodious, like that of Yokohama, and accessible to all ships. In consular reports Hiogo, the older town, is always named in its stead; not so in the yearly reports of the Japanese custom-house.

The trade of Kobe, indeed, is far behind that of Yokohama, but it exceeds by more than threefold that of Nagasaki, and will probably increase considerably through the new railway connections with the interior viâ Kiôto. Kobe exports most of the copper, sumach-tallow, and camphor, as well as rice. In its shipments of tea it comes next to Yokohama. Among its principal imports are gold and silver bars for the mint in Ôsaka, besides cotton and woollen goods, sugar, and petroleum. The tax-reports for the commerce of Kobe-Ôsaka for each of the last nine years show a marked deficiency of exports as compared with imports, since the latter always far exceeded the former in value. Accordingly, during the last five years, 28·8 per cent. of Japan's total imports came through Kobe-Ôsaka, while only 20 per cent. of its exports were shipped thence.

The foreign population of Kobe was composed, in 1883, of 610 Chinese, 232 British subjects, 48 Germans, 33 North Americans, 17 Portuguese, 14 French, 12 Dutch, 6 Scandinavians, 5 Danes, 1 Swiss, and 1 Austrian. There were 84 business firms, namely, 33 Chinese, 30 British, 11 German, 9 American, and 1 Portuguese.

Nagasaki.—The relation between imports and exports of this place is the reverse of that at Kobe. It has not populous cities behind it as purchasers, while its exports have increased notably, owing to several favourable circumstances. One of these is the greater proximity of the continent of Asia. Another is the regular steamer service with Shanghai, Fusan, and Wönsan (Gensan) in Corea, and Wladiwostok; another the increasing output of the neighbouring coal-mines, especially those of Takashima. Coal, dried marine animals, rice, camphor, tea, and sumach-tallow, are the chief articles of export; while tobacco is now shipped in greater quantities viâ Yokohama and Kobe.

As in the other treaty-ports, the clean and spacious European quarter lies along the harbour, while the Chinese live in the back-ground. In 1883 there were altogether 892 foreigners, of whom 642 were Chinese, 95 British subjects, 42 North Americans, 34 French, 19 Austrians, 17 Germans, and 41 persons of other nationalities. There were 19 Chinese business firms, 7 British, 4 German, 3 American, 2 French, 1 Austrian, but no Dutch.

Hakodate.—The foreign trade of this well-known port on the island of Yezo has not acquired large dimensions. The direct importation of foreign wares is especially small, as is seen in Table I. The exportation there given according to value embraces principally algæ and various marine animals, besides wood, sulphur, deer-skins and antlers. The marine products go mostly to China, likewise the wood; the others to North America and England. The foreign trade of Hakodate was carried on in 1883 by two English firms and one Danish. Among its 93 foreigners were 39 Chinese, 15 English, 8 Americans, 8 Frenchmen, 2 Danes, and 1 German.

The commerce between Hakodate and several smaller ports on the island of Yezo, with Hondo and other Japanese islands, is much more important. According to the English consular report of the year 1883, the two government districts, Hakodate and Sapporo (there are no returns for Nemuro, the third), in 1882 exported products worth 5,072,635 yen, and imported others worth 7,918,936 yen. Among the exports we find 1,735,853 yen-worth of fish, especially salmon and herring, besides algæ and inferior marine animals, and 2,588,483 yen worth of fish-guano, *i.e.* more than half the total exportation of Yezo. The principal articles of import are rice, saké, and cotton goods.

Niigata, the capital of the province of Echigo, on the left bank of the Shinano-gawa, shortly before its union with the Japan Sea, has been already described in vol. i. p. 502, as a treaty-port that has by no means met the expectations of foreigners. The bar before the river mouth is covered at low tide by only two meters of water. Moreover, the coast forms an open roadstead without protection from the heavy northerly winds in the long winter. At that season, therefore, navigation comes for the most part to a standstill. The chief exports are rice and tea; the direct imports are scarcely worth mentioning, since the few foreign merchants, like the natives, supply their needs through business friends at Yokohama. For these reasons the port of Niigata is no longer mentioned in commercial reports from Japan. It finds no place, therefore, in the business statistics given as a supplement to this chapter.

Figures demonstrate. I took them partly from the publications of the Japanese customs department, partly from the English consular reports, and arranged them in the different tables, so that a comprehensive picture of the total foreign commerce of Japan could be obtained. These statistics are made in yen, the customary coin of the realm, and embrace :—

I. Value of exports and imports of Japan from 1868–1885 through the several treaty ports.

II. Foreign commerce of Japan during the last five years, arranged by countries.

III. Survey of the principal articles of export since 1868, according to groups and value.

IV. Principal articles of export with their values during the years 1881–1885.

V. Review of exportation in 1885, according to articles, countries, and value.

VI. Comparative table of the importation and exportation of gold and silver in coins and bars.

VII. Review of the principal articles of import since 1868, and of their value.

VIII. Importation of prominent articles in 1885, according to countries and value.

Trade reports during the transition period from the conclusion of the first treaties till 1868 are incomplete, and had to be left out. Those of the first five years Meiji (1868–1872) are inaccurate. But that is not to say that the later customs registers agree everywhere. In general there is a notable increase of exportation and importation, though without steadiness, which was not to be expected, since the same general causes here as elsewhere caused great fluctuations in trade.

Large purchases, whatever their causes, always occasion an unnatural swelling of the import figures, and are generally soon followed by a reaction, just as extraordinary advances in prices for any article are as a rule only transitory. War and preparations for war raise the price of war materials and the necessaries of life. Rich harvests, which greatly increase exportation, raise the import figures for clothing stuff and other comforts and necessities of life. All these phenomena are seen in the commercial statistics of Japan. But as the consular reports dwell upon them sufficiently, I prefer to emphasize certain other points.

Raw silk with its by-products has stood far in advance of the other articles of export in value, ever since the country was opened. It is likely, moreover, to maintain this supremacy. When its exportation began, in 1859, and for the next ten years, the silkworm disease in Europe made the greatest depredations on European sericulture, so that the demand for oriental silk advanced enormously, and consequently the price also. A further increase of price was occasioned by the high cost of cotton during the American civil war. On account of both these causes raw silk reached in 1865 more than double its price in 1863; and the exportation of silk from Yokohama amounted to 17,467,728 yen, despite a small falling off in quantity, whereas in 1863 it was only 8,997,484 yen. Considerable transient advances in the price of silk have occurred several times since, as in the spring of 1876 and 1879, though none to equal those earlier rises. The raw silk is exported in bales of 80 Catties or four-fifths Pikul (about 100 English pounds). The largest quantity, 56,432 Pikul, was shipped in 1883—but in this figure the refuse is included. In 1882 the shipments of all the products of silk culture reached the largest sum, 19,146,223 yen. The highest price for the best Mayebashi silk was paid in 1868–69, when the Pikul was worth 900–1070 yen. Since then prices have much sunk ; and yet increased production has sufficed to cover not only this fall in price, but also the decrease in sales of silkworm eggs. The products of silk-culture were 45·71 per cent. of the total exports in the last five years, as opposed to 46·46 per cent. in the period 1871–1875, although then 9·03 per cent. stood for silkworm eggs. This branch of the business, which in 1868 reached a value for exports of 3,700,000 yen, is now nearly extinct.

Some information as to tea, the second export article, which reached its highest value in 1874, is to be found in the map at the end of this book. The exportation of coal, given in Table III A, embraces also the supplies to foreign ships. The exportation of rice is, of course, subject to great fluctuations. Considerable advance is shown in the exportation of industrial art products. Under this title all art products are not included, but only lacquer-wares, clay-wares, wall-screens, fans, bamboo-wares, bronze, and enamelled articles.

Especially interesting is the exportation of mushrooms and marine products, 7·82 per cent. of the total export of objects that go almost exclusively to China, forming nowhere else such a considerable factor in trade. Moreover, this line of exports is continually increasing. The following may serve as supplementary matter to what has been already said on pp. 77–82, and pp. 109, 110 and 532 :—

Under the term Kai-san-rui, *i.e.* marine products, the Japanese customs-register embraces algæ and marine animals. The shipments of Kántén—according to Table IV. averaging about 300,000 yen annually—take place mostly from Kobe and Ôsaka ; those of dried algæ largely from Hakodate. The cold waters of the coast of Yezo are the home of the kelp-weeds, so much in request with the Chinese, and among which Konbu (pronounced Kombu), the sweet tangle (*Laminaria saccharina*), ranks highest. It is shipped in two forms—as Ha-kombu in whole leaves, and as Kisami-kombu or cut Kombu. The average export from Hakodate to China during the last five years amounted to 375,401 yen of Ha-kombu and 26,193 yen of Kisami-kombu, or both together 401,596 yen. Besides this, considerable quantities of this article came directly from Yezo, viâ Yokohama, Kobe, and Ôsaka, to the Chinese. The average exportation of algæ from Japan (not including Kántén) had reached lately a value of 546,396 yen.

The various sea animals which constitute valuable articles of export to China deserve especial mention. The English consular reports frequently include them all under the title "dried fish." Following their order in the Japanese customs-register, where they are usually designated with the epithet Hoshi, "dried," we find first :—

(*a*) Iriko, Trepang,[1] sea-cucumber, sea-slug. Bêche de Mer (*Holothuria edulis*). English consular reports mention this article either by its Japanese or French name. Iriko is found on all Japanese coasts. The value of the yearly exportation during the last five years averaged 216,973 yen.

(*b*) Surume (*Onychoteuthis Banksii*). All cephalopods which are used in Japan and China for food are embraced in trade lists under the name ink-fish, Jap. Ika, and cuttlefish, Jap. Tako (*Octopus*). Surume heads the list in Japan ; Ika-surume (*Ommastrephes*), Tako, Shi-dako (*Eledone*), and Tachi-ika (*Loligo* and *Loligopsis*) are much used. Most of these creatures move about in shoals, coming and going often with arrow-like rapidity, and in some years appearing frequently on certain coasts, in others only in small numbers, changing their course, like other wandering marine animals. The average value of the shipments of these cephalopods from all Japanese ports during 1881–1885 was 705,110 yen. Besides these, quantities are eaten in the country itself.

(*c*) Hoshi-Awabi, dried mussel of the ear-shell (*Haliotis gigantea* and *H. japonica*). The annual value of exports of these the most important Japanese mussels, amounts to 378,000 yen. To this must be added shells that bear mother of pearl, with a value of 18,000 to 20,000 yen. By far the greatest amount of Hoshi-Awabi is shipped from Yokohama. All other mussels that are exported are usually embraced in the term Hoshi-gai-rui, dried mussels. To these belong Hamaguri (*Cytherea meretrix*, Lin., *C. lusoria*, Chann.), Kaibashi-rui (species of arks), Aka-gai (*Scapharca inflata*, Reeve), and many others.

(*d*) Hoshi-ebi, dried crabs. The English consular reports mention this article by the name of shrimps (Jap. Shiba-ebi) ; but there are many varieties. The amount exported annually is considerable (see Table IV.).

(*e*) Fuka-no-hire, shark's-fins, a well-known delicacy of the Chinese. The mean value of the annual exportation of 1881–1885 was 57,107 yen.

(*f*) Shiwo-shake, salted salmon, chiefly from Yezo, where the Shake (*Oncorhynchus Haberi*, Hlgd.) and the Masu (*O. Perryi*, Brevoort) occur in great numbers, especially in the lower Ishikari.

[1] The edible Holothuria, known by the Chinese name Trepang, are also gathered on the shores of the Malay Archipelago, and of many South Sea Islands, where they lie apparently motionless on sandy ground. Out of water, they die immediately and become a slimy mass. They must therefore be cut up at once, the digestive canal being taken out, and then they are dipped in boiling water and dried in the air.

(*g*) Shiwo-tara, salted haddock (*Gadus Brandtii*, Hilgdf.) from Yezo.

Numberless varieties of the herring family furnish fish-oil, Giotô or Uwo-no-abura, of which for about 146,000 yen goes annually to foreign countries, and the highly prized fish-guano, Jap. Ko-washi, also called Shime-kasu, *i.e.* pressed refuse.

The outward trade of Japan is for the most part in foreign hands. Of its total exchanges in 1885, with a value, in round numbers, of 64½ million yen, only 5·74 million, *i.e.* about one-eleventh, passed through Japanese houses, and this small fraction refers almost wholly to the trade with China and Corea.

In steamer communication with Japan, as in shipping generally, England stands far ahead of all other countries. It is followed by France, Germany, and the United States.

As may be seen from Table II., the United States, France, and China consume more of the chief export articles than the British Empire. Germany ranks only sixth, but in importation has lately passed France and reached the fifth place. Table V. furnishes a view of the division of the chief export articles according to countries. The value of the foremost purchaser of each article is printed in italics. The same has been done concerning importation, as represented in Table VIII. The lion's share here falls to England. Together with India (Bombay) it furnishes in the first instance the vast quantity of cotton yarn which Japan takes for weaving, as well as cotton fabrics themselves. It also far precedes all other countries in woollen cloths and blankets, and half-wool Italian cloth. Its competitor in woollen stuffs, Germany, furnishes the most flannel and half-silk stuffs. One of the favourite woollen articles, for women's chemises, is cochineal-red muslin. France sends most of this, from Rouen. Germany follows as a good second. Metal importation is mostly from England. China provides sugar, from Canton, Swatau, Amoy, and Formosa. Petroleum comes from North America. After insufficient harvests, India and Siam supply most of the demand for rice ; and great part of the tortoise-shell is sent by them, viâ Singapore. That the United States furnish the most leather, France the most wine, Belgium the most glass and glass-ware, Switzerland the largest number of watches, Italy the coral, is likewise to be seen from Table VIII. Of drugs and dye-stuffs England furnishes more than China and Germany, although the latter ships aniline dyes of the value of 93,000 yen to Japan. Spain is first in quicksilver and saffron ; Australia sends the wool which has been worked up since October, 1879, when the first cloth manufactory was established. It is situated at Senju near Tôkio, having been set up by the Hartmann machine factory of Chemnitz at the instance of the government. It is under German management.

When Japan was opened to foreign commerce, people in Christian, industrial and commercial states indulged in golden expectations about this new field. They hoped that the efforts of the Japanese to appropriate occidental means of education, intercourse, and defence would soon extend to their manner of life, housekeeping, and clothing. In this confidence they ventured upon daring speculations, without remembering that the multitude possessed neither inclination nor means to forsake their old customs. Side by side with highly respectable houses, in the treaty ports, many persons without resources or experience, or with elastic consciences, established themselves. As agents, they received, held, and stored all sorts of European and American manufactures on commission, with very little prospect of speedy sale. The storage charges grew to be enormous; the manufacturer pressed them to sell; and consequently the goods were often disposed of at public auction, with scarcely enough profit to cover their cost. In consequence of these unsound relations, many things, such as umbrellas, hats, and flannels, could be purchased cheaper from Japanese shopkeepers than in the land of their production. And it often happened, too, that the worst sort of goods came in this way into Japan, *e.g.* wretched shoes, which went to pieces after being worn a few times. These and various other obstacles long stood in the way of a healthy development of the import trade. And to exportation also there were many hindrances.

In its foreign commerce Japan appears like a young colony going through a rapid transition in its economics. In the three decades of its freer development it has conquered many extraordinary difficulties in a most surprising manner, and has exhibited a vitality that is astounding. On several occasions there was cause to fear political and economical bankruptcy. Instead of this, the body politic has grown stronger and healthier, and the prospects of a flourishing development of intellectual and material life are greater than ever before. The financial difficulties culminated at the time of the Satsuma rebellion (1877), when the national treasury was empty, and the negative exchanges of many years had caused a dangerous scarcity of cash. The government was compelled to issue a large amount of paper money, or Kinsatsu. This, in consequence of its incalculable sudden fluctuations, became a universal obstacle to trade. Cash had become so scarce that, for example, Enslie, the English consul at Niigata, expressed the opinion, in his report for October, 1878, that there were not twenty-five gold and silver yen pieces in circulation in the great Niigata-ken, with a population of $1\frac{1}{2}$ millions.[1]

Kinsatsu formerly stood at par—nay, was in the home trade even preferred to real money. Now its worth sank so much that one had to allow for the constant fluctuation of a considerable agio, which occasionally amounted to 180 per cent. Not until of late

[1] "The only currency used here is paper money, gold and silver are never met with nowadays, and I think I may safely say that there are not twenty-five gold and silver yen in circulation throughout the whole Ken."

years has the government succeeded in raising its credit again and making an end of this great burden to commerce. The most successful of the means employed lay near at hand, and consisted in putting a stop to the negative balances. The government had this in its own hands, in so far as it diminished its requirements, and therewith did away with a considerable part of the importation necessary to meet them.

Those who, in reports from Japan, condemned the government for endeavouring to prevent the excess of importation over exportation, and pointed to England and other European countries, showed ignorance of the circumstances. It is true that under-balances are the rule in England, without causing disturbances and apprehension. But in her case the balances are made up by immense investments of capital in other countries, as can be seen in the statistics of commerce. For a country like Japan, on the contrary, where this is not the case, the relation of imports to exports furnishes the best measure of economic prosperity. Negative balances must here be covered by exportations of cash or by loans; and if they continue to occur, must be regarded as a sign of impoverishment and decreasing productiveness.

In the Table I. D, the under-balances are given with —, the positive annual balances with +. It is to be observed in this list that in the eighteen years of Meiji (peace, the designation of the very remarkable reign of Tennô Mutsu Hito) the sum of negative balances was 87,719,877 yen, but of positive only 36,370,757 yen. Of the latter, 27,763,507 yen fall to the last four years. To these favourable balances since 1882 corresponds the balance between the importation and exportation of precious metals, as given in Table VI., where it is shown that in the same period, 1882–1885, there was an excess of 7,822,545 yen of importation over exportation. It consisted chiefly in the importation of silver dollars, and served in part to equalize the excess of exported over imported goods.

The foreign trade of Japan had become more and more obstructed under the Tokugawa Shôgunate, so that the country's resources could not be symmetrically and vigorously developed. Since the restoration of Mikado rule, the country has become astonishingly more productive, and consequently consumes more, although the mining of gold and silver—formerly the principal source of business with foreign lands—yields but light returns. In the period of five years 1871–1875 (see Table III. B), the average annual value of exports was 18,577,056 yen. Ten years later, in the same interval, between 1880 and 1886, it had risen to 34,454,812 yen, almost double what it was before.

Countries which export one article almost exclusively are placed in a bad position when this fails or sinks in value, as has been abundantly proved recently by Nevada with its mining, the Canary Islands with their cochineal-raising, and many tropical colonies with their chief product, raw sugar. In Japan, the products of silk-culture and tea-raising in the five years 1871–1875 furnished not less than 77·90 per cent. in value, that is, over three-fourths of the total exportation; but in the period 1881–1885, despite an absolute increase, only 64·66 per cent. This proportionate decrease, as compared with the almost doubled total, falls to tea. Japanese tea has only one purchaser, so that it would be altogether marketless in case of a change in the American taste. The decrease, from 31·44 per cent. to 18·05 per cent. in its share of the total exportation, and the corresponding increase on the part of other articles, are therefore favourable signs.

Further increase and strengthening of Japan's exporting capability may be expected from the improvement of waste lands and forests by good farming and greater transportation facilities, as well as from the continued development of industrial art and branches of labour. Many obstacles remain yet to be surmounted; but a government which works together with the people for an acknowledged end, and has already overcome greater difficulties, will gain its purpose here also.

During recent years the hope has often been expressed in mercantile circles that the opening of new ports and the repeal of existing restraints to intercourse would bring about a new revival of the foreign trade of Japan; but I do not at all agree with this. The country does not possess an unknown background with concealed treasures, for raising which the advent of foreign merchants are alone necessary; nor a population which does not buy imported articles simply because of its distance from the treaty ports. Goods go easily and cheaply, by means of Japanese steamers, to all ports, and from them to the interior, wherever they are in demand.

As was pointed out in vol. i., the question of completely opening Japan has often been weighed by the representatives of foreign powers and the Mikado's government. Political and material considerations of an important character which are connected with the work of consular jurisdiction have hitherto stood in the way. The Japanese government demands, first of all, the abolition of this system and the subjection of foreigners to the laws of the country. Not only judiciousness, but also its dignity and self-respect, demand that this point be insisted upon; and there is scarcely any doubt but that this view will be universally recognised and admitted in the approaching revision of the treaties.

STATISTICS.

I. Value of the Exports and Imports of Japan,

Year.	Exports. Yokohama.	Kobe-Ôsaka.	Nagasaki.	Hakodate.	Im- Yokohama.	Kobe-Ôsaka.
	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.
1868	17,698,406	388,096	1,988,190	360,441	12,397,149	821,904
1869	9,083,302	815,674	1,323,268	263,401	12,617,174	2,087,052
1870	11,331,482	2,399,567	1,325,539	86,658	23,428,965	5,133,605
1871	14,431,486	2,081,790	2,379,946	291,583	14,445,231	1,739,342
1872	15,095,218	5,678,224	2,742,786	416,717	20,063,125	4,246,779
1873	15,335,249	3,355,776	2,002,815	447,610	19,387,052	6,263,129
1874	13,062,984	3,621,889	1,816,276	278,874	16,390,822	4,958,433
1875	12,466,654	2,987,378	2,117,487	395,997	22,035,450	5,870,307
1876	21,431,741	3,492,305	1,824,711	476,401	18,537,643	4,136,663
1877	15,628,337	4,786,171	2,054,925	483,047	20,754,757	4,727,512
1878	15,226,592	6,594,048	2,398,503	721,542	24,619,142	6,448,624
1879	18,870,273	5,801,594	1,976,766	692,524	23,226,010	7,571,494
1880	18,573,577	5,791,792	2,298,467	749,262	25,940,356	8,736,292
1881	21,135,376	5,876,047	2,381,605	826,374	21,291,958	8,393,185
1882	26,659,807	6,757,624	3,313,390	504,953	20,119,061	7,884,481
1883	25,685,064	6,464,835	3,106,767	436,750	18,844,810	8,255,327
1884	21,416,961	7,325,491	3,772,513	378,913	19,039,991	8,841,126
1885	23,850,398	8,059,091	3,496,261	681,294	18,630,379	8,525,147

II. The Foreign Trade of Japan

A. Exports to

	1881.	1882.	1883.	1884.	1885.	Total.	Average.
	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.
United States	11,056,465	14,253,292	13,247,840	13,107,233	15,613,869	67,278,339	13,455,668
France . .	8,332,562	10,313,970	9,713,222	6,778,097	6,735,912	41,974,441	8,394,888
China . . .	5,558,483	5,301,399	5,482,936	6,045,357	7,655,469	30,043,644	6,008,729
England . .	3,514,477	4,981,546	4,832,008	3,801,731	2,411,979	19,541,741	3,908,348
India and Siam . .	122,971	360,291	410,263	527,681	482,084	1,913,290	382,658
Germany .	177,407	458,627	245,765	511,565	463,933	1,857,297	371,459
Australia. .	148,933	160,333	434,618	245,185	284,236	1,273,305	254,661
Italy . . .	403,138	351,713	140,558	65,740	120,594	1,081,743	216,349
Russia . .	73,835	99,492	169,226	144,557	246,292	733,786	146,757
Corea . . .	126,981	64,085	47,369	174,452	229,600	640,397	128,097
Austria . .	96,080	121,049	23,767	76,129	21,607	338,632	67,726
Belgium . .	3,806	793	6,950	3,362	68,270	83,181	16,636
Switzerland.	729	21,708	1,914	—	44,060	68,411	13,682
Holland . .	5,837	8,985	3,434	2,409	42,526	63,191	12,638
Other Exports	597,829	738,513	913,653	1,532,932	1,688,450	5,471,377	1,094,275
Total . .	30,219,443	37,235,776	35,693,523	33,016,430	36,108,886	172,162,775	34,472,555

FROM 1868–1885, AT THE SEPARATE TREATY PORTS.

Ports.		Total Value of			Difference between Imports and Exports.
Nagasaki.	Hakodate.	Exports.	Imports.	Trade.	
Yen.	Yen.	Yen.	Yen.	Yen.	Yen.
1,774,998	6,320	15,553,473	10,693,072	26,246,545	+ 4,860,401
2,609,465	4,324	12,908,978	20,783,633	33,692,611	− 7,874,655
2,499,857	58,214	14,543,013	33,741,637	48,284,650	−19,198,625
1,545,432	15,600	17,968,609	21,916,728	39,885,337	− 3,948,119
1,856,549	24,988	17,026,647	26,174,815	43,201,462	− 9,148,168
1,927,761	32,247	21,142,015	27,617,264	48,759,279	− 6,475,249
1,550,063	16,419	18,780,079	22,924,587	41,704,666	− 4,144,508
1,368,569	37,762	17,967,930	29,332,447	47,300,377	−11,364,517
782,444	20,088	27,225,157	23,478,308	50,703,465	+ 3,746,849
1,565,838	14,628	22,976,416	27,062,797	50,039,213	− 4,086,381
1,474,954	13,334	25,524,571	32,563,265	58,087,836	− 7,039,294
1,706,078	4,187	27,388,961	32,508,369	59,897,330	− 5,119,408
1,277,396	221,704	27,413,160	36,176,087	63,589,247	− 8,762,926
983,164	128,273	30,219,443	30,797,470	61,016,913	− 578,027
1,156,782	7,417	37,235,776	29,168,041	66,403,817	+ 8,067,735
867,617	4,378	35,693,523	27,973,532	63,667,055	+ 7,719,991
855,742	5,004	33,016,430	28,821,027	61,837,457	+ 4,195,402
1,139,324	6,765	36,108,886	28,328,508	64,437,394	+ 7,780,379

DURING THE LAST FIVE YEARS.

	B. Imports from						
	1881.	1882.	1883.	1884.	1885.	Total.	Average.
	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.
England . .	16,364,741	13,956,049	12,744,944	12,729,853	12,415,422	68,211,009	13,642,202
China. . .	5,205,584	6,350,381	5,425,440	6,517,742	5,763,050	29,262,197	5,852,439
United States	1,785,108	3,106,758	3,187,114	2,466,279	2,726,185	13,271,444	2,654,289
India and Siam . .	2,209,158	2,304,506	2,453,283	2,342,427	3,396,965	12,706,339	2,581,268
France . .	3,191,050	1,461,085	1,865,665	1,564,480	1,329,866	9,412,146	1,882,429
Germany. .	857,731	1,193,395	1,416,510	2,310,492	1,665,653	7,443,781	1,488,756
Switzerland.	376,590	321,981	253,023	287,772	306,255	1,545,621	309,124
Corea . . .	225,325	514,652	189,281	244,787	239,515	1,413,560	282,712
Belgium . .	389,588	128,932	268,913	202,653	317,683	1,307,779	261,554
Italy . . .	176,933	111,785	155,405	88,879	95,998	629,000	125,800
Australia. .	71,327	74,302	87,170	25,589	71,322	329,710	65,942
Spain . . .	17,079	18,063	17,385	17,705	29,901	100,133	20,027
Denmark .	10,814	13,408	14,844	15,961	23,286	78,313	15,663
Holland . .	8,468	12,415	15,056	17,397	20,105	73,441	14,688
Other countries . .	133,299	114,981	68,780	233,898	166,817	717,775	143,555
Total . .	31,022,795	29,682,693	28,162,813	29,065,814	28,568,023	146,502,138	29,340,448

III. A. Summary of the most Important Articles of

Year.	Raw Silk.	Silk Refuse of all Kinds.	Silkworms' Eggs.	Total Silk Industry.	Tea.	Copper.	Coals.
	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.
1885	13,033,872	1,393,577	33,331	14,460,780	6,815,295	1,825,065	2,000,000
1884	11,007,172	2,216,323	40,708	13,264,203	5,794,159	1,386,799	1,828,264
1883	16,183,550	2,285,325	55,287	18,524,162	6,074,312	724,819	1,373,570
1882	16,232,148	2,791,590	122,485	19,146,223	6,983,920	827,181	1,197,053
1881	10,647,310	2,456,904	311,140	13,415,354	7,020,859	709,846	1,084,345
1880	8,606,866	1,467,277	991,021	11,065,164	7,497,922	853,717	1,085,537
1879	9,734,534	1,411,856	582,623	11,729,013	7,445,489	508,842	754,669
1878	7,889,446	896,458	650,101	9,436,005	4,248,173	852,157	833,516
1877	9,626,331	423,107	346,998	10,396,506	4,409,320	828,111	717,819
1876	13,257,742	1,111,559	1,902,271	16,271,372	5,427,218	289,708	765,726
1875	5,424,916	563,264	474,921	6,463,101	6,915,692	425,160	871,795
1874	5,301,755	318,560	731,275	6,351,590	7,792,244	559,397	551,360
1873	7,150,605	362,438	3,032,460	10,545,503	4,398,711	765,815	489,278
1872	7,227,287	911,856	1,963,159	9,152,302	5,445,438	1,353,545	324,000
1871	8,168,735	288,905	2,184,688	10,642,328	4,651,292	416,630	470,600
1870	4,929,800	388,573	3,473,150	8,591,523	1,088,863	461,093	144,860
1869	4,603,510	65,077	2,019,130	6,687,717	2,019,130	168,202	79,610
1868	6,253,472	407,590	3,712,351	10,373,413	3,084,580	28,226	84,279

III. B. (*a.*) Totals, (*b.*) Average Value and (*c.*) Percentage of the Five-year Periods 1871-75 and 1881-85,

a.							
1881—85	67,104,052	11,143,719	573,521	78,810,722	32,688,545	5,473,710	7,483,232
1871—75	33,323,298	2,445,023	8,386,503	43,154,824	29,203,177	3,520,547	2,707,033
b.							
1881—85	13,420,810	2,228,745	114,650	15,762,144	6,537,709	1,094,742	1,496,646
1871—75	6,664,659	489,005	1,677,301	8,630,965	5,840,635	704,109	541,407
c.							
1881—85	38·91 %	6·46 %	0·33 %	45·71 %	18·95 %	3·29 %	4·34 %
1871—75	35·88 %	2·63 %	9·03 %	46·46 %	31·44 %	3·79 %	2·91 %

EXPORT SINCE 1868—ACCORDING TO CLASS AND VALUE.

Tobacco	Vegetable Tallow.	Camphor.	Rice.	Mush-rooms.	Algæ and Kanten.	Sea Animals.	Objects of Art Industry.
Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.
389,287	371,878	558,646	766,759	334,292	998,507	2,070,777	1,706,680
239,306	136,633	549,503	2,169,942	321,245	672,518	1,436,821	1,769,044
121,988	39,089	707,993	1,000,941	337,797	588,160	1,556,323	1,566,285
76,217	326,364	869,126	1,652,040	332,103	741,389	1,441,504	607,529
237,616	301,148	706,135	261,735	381,468	1,172,899	1,104,438	1,918,678
204,168	245,968	596,628	210,405	340,700	802,478	1,358,186	1,427,287
141,653	329,974	455,289	375,943	245,581	483,934	1,194,650	1,097,724
106,538	99,909	390,044	4,644,280	194,506	685,381	1,062,695	470,317
229,288	164,977	240,065	2,260,936	337,061	641,336	857,811	476,937
83,496	177,398	182,477	810,760	343,231	977,699	952,975	328,811
201,148	186,244	136,073	17,031	222,700	536,373	683,007	558,422
259,687	215,642	119,812	839,619	226,937	449,233	903,773	445,224
274,529	377,670	71,026	521,709	141,250	727,472	770,581	608,782
669,340	347,542	152,879	3,122,931	82,030	447,391	625,778	517,923
269,359	161,834	138,575	—	149,544	510,200	332,215	79,590
94,112	64,190	228,889	—	185,123	341,320	405,027	uncertain
21,806	98,402	168,202	—	131,556	426,176	183,941	"
41,357	308,468	77,097	—	116,017	276,979	280,491	"

THE EXPORT OF ABOVE ARTICLES ON THE TOTAL EXPORT OF AND CALCULATED FROM ABOVE STATEMENTS.

1,064,414	1,175,112	3,391,403	5,851,417	1,706,905	4,173,473	7,609,863	7,568,216
2,574,063	1,288,932	618,365	4,501,290	832,461	2,670,659	3,315,354	2,209,941
212,883	235,022	678,281	1,170,283	341,381	834,695	1,521,973	1,513,643
514,813	257,786	123,673	900,258	164,492	534,132	663,071	441,988
0·62 %	0·68 %	1·97 %	3·39 %	0·99 %	2·42 %	4·41 %	4·39 %
2·77 %	1·39 %	0·67 %	4·85 %	0·89 %	2·87 %	3·57 %	2·38 %

Chief Articles of Export, and their Value, during the Years 1881–85.

Articles.	1885.	1884.	1883.	1882.	1881.
	Yen.	Yen.	Yen.	Yen.	Yen.
Silk	14,427,449	13,223,495	18,468,875	19,023,738	13,104,214
Silkworms' Eggs	33,331	40,708	55,287	122,485	311,140
Tea	6,815,295	5,794,159	6,074,312	6,983,902	7,020,859
Copper	1,825,065	1,386,799	724,819	827,181	709,846
Antimony	183,290	73,847	140,245	101,110	48,842
Sulphur	137,932	66,645	119,765	31,224	65,931
Sulphuric Acid	66,306	65,969	25,474	40,359	111,391
Coals[1]	2,000,000	1,828,264	1,373,570	1,197,053	1,084,345
Wood	86,483	48,003	72,737	195,396	127,660
Tobacco	389,287	239,306	121,988	76,217	237,616
Vegetable Tallow	371,878	136,633	39,089	326,364	301,148
Camphor	558,646	549,503	707,993	869,126	706,135
Ginseng	94,661	66,318	87,069	94,909	36,558
Rice	766,759	2,169,942	1,000,941	1,652,040	261,735
Wheat and Flour	356,391	246,245	593,611	54,576	6,097
Mushrooms	334,292	321,245	337,797	332,103	381,468
Algæ	652,787	363,434	345,755	530,154	839,852
Kanten	345,720	309,084	242,405	211,235	333,047
Cuttle-fish	903,742	789,103	802,986	648,681	381,037
Molluscs	387,731	369,293	300,578	285,920	235,523
Trepang	177,286	150,048	205,199	271,883	280,448
Prawns	73,967	44,760	39,124	35,052	15,951
Fish	84,633	84,893	59,491	48,865	39,219
Shark's-fins	63,284	70,052	50,063	51,972	50,184
Fish Oil	99,667	312,984	153,782	105,782	58,354
Skins and Furs	220,142	134,656	48,676	uncertain	uncertain
Rags	243,077	192,374	40,682	22,606	6,089
Cotton Goods	176,814	104,617	61,910	32,002	30,458
Silk Goods	54,547	24,021	22,727	68,560	81,909
Clay-wares	695,269	525,927	543,763	578,636	772,127
Lacquered Goods	467,521	451,662	519,720	555,299	525,382
Fans	107,945	94,992	89,060	156,854	267,433
Screens	148,640	143,496	102,216	87,463	100,979
Paper	102,329	130,372	235,935	173,329	126,276
Bronze	125,535	129,163	99,254	87,157	92,903
Bamboo-wares	105,986	78,352	126,816	82,369	80,227

[1] Export and Supply of Foreign Vessels included.

SUMMARY OF THE EXPORTS FOR 1885, ACCORDING TO GOODS, COUNTRIES, AND VALUE IN YEN.

GOODS.	United States.	China.	France.	England.	India and Siam.	Germany.	Australia.	Russia.	Corea.	Italy.
	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.
Raw Silk and Silk waste	7,538,124	—	6,171,424	580,999	—	—	—	—	—	85,137
Silkworms' eggs	—	—	14,331	—	—	—	—	—	—	26,420
Silk goods	164,000	—	6,858	14,018	5,040	202	4,663	7,807	28,005	102
Cotton goods	2,711	153,787	48	618	284	50	—	1,828	20,803	—
Paper and Leather-paper	58,621	—	—	24,296	1,253	1,540	538	1,072	1,909	—
Tea	6,797,766	—	2,954	5,543	67	282	1,285	198	845	—
Vegetable Tallow	30,990	172,999	30,986	94,654	2,211	38,969	571	122	—	—
Camphor	140,011	385,207	—	5,972	2,650	18,735	—	—	—	—
Ginseng	—	94,650	—	—	—	—	—	—	—	—
Tobacco	—	—	—	364,382	—	112	—	—	—	—
Rice	—	54,922	—	102,406	—	129,353	216,234	81,702	41,065	—
Wheat and Flour	—	240,864	—	—	—	—	—	107,967	6,959	—
Mushrooms	4,647	329,559	—	—	13	—	—	51	—	—
Kanten	6,221	322,159	—	3,525	—	7,214	—	49	—	—
Algæ	—	652,709	—	—	—	—	—	—	—	—
Fish	—	183,135	—	42	—	—	—	—	—	—
Shark's-fins	—	63,284	—	—	—	—	—	—	—	—
Fish oil	284	4,194	—	26,600	223	39,497	1,411	100	118	1,050
Cuttle fish	646	903,053	—	—	—	—	—	—	—	—
Molluscs	3,196	511,340	—	—	—	—	—	—	—	—
Trepang	—	177,278	—	—	—	—	—	—	—	—
Copper	—	1,147,867	30,622	332,148	427,557	29,902	—	—	31,632	—
Antimony	11,349	—	5,161	140,773	—	1,639	—	—	—	155
Coals	—	617,101	—	—	—	—	—	7,876	1,338	—
Sulphur	82,539	—	—	226	200	—	17,260	718	1,839	—
Sulphuric acid	—	66,306	—	—	—	—	—	—	—	—
Bronze	—	—	50,592	34,778	3,367	10,714	1,691	325	—	235
Clay-wares	127,471	170,427	124,335	203,946	15,882	27,724	17,718	1,758	4,249	795
Lacquered goods	51,018	188,117	38,920	114,608	9,121	52,825	6,405	1,166	2,117	133
Bamboo-ware	29,239	—	8,341	43,066	550	10,714	1,341	356	314	935
Fans	79,558	—	10,596	8,072	785	3,259	145	12	319	380
Screens	24,911	—	13,977	84,697	3,006	3,087	4,818	152	9	395
Wood	—	83,829	48	281	—	1,543	—	—	2,007	—
Hides	4,310	89,252	16,690	68,398	—	40,351	—	—	—	900
Other Articles	456,257	984,809	210,029	157,930	19,875	46,221	10,156	33,033	86,072	3,957
Total value	15,613,869	7,655,469	6,735,912	2,411,978	492,084	463,933	284,236	246,292	229,600	120,594

Comparative Table of the Import and Export of Gold and Silver in Coin and Bars.

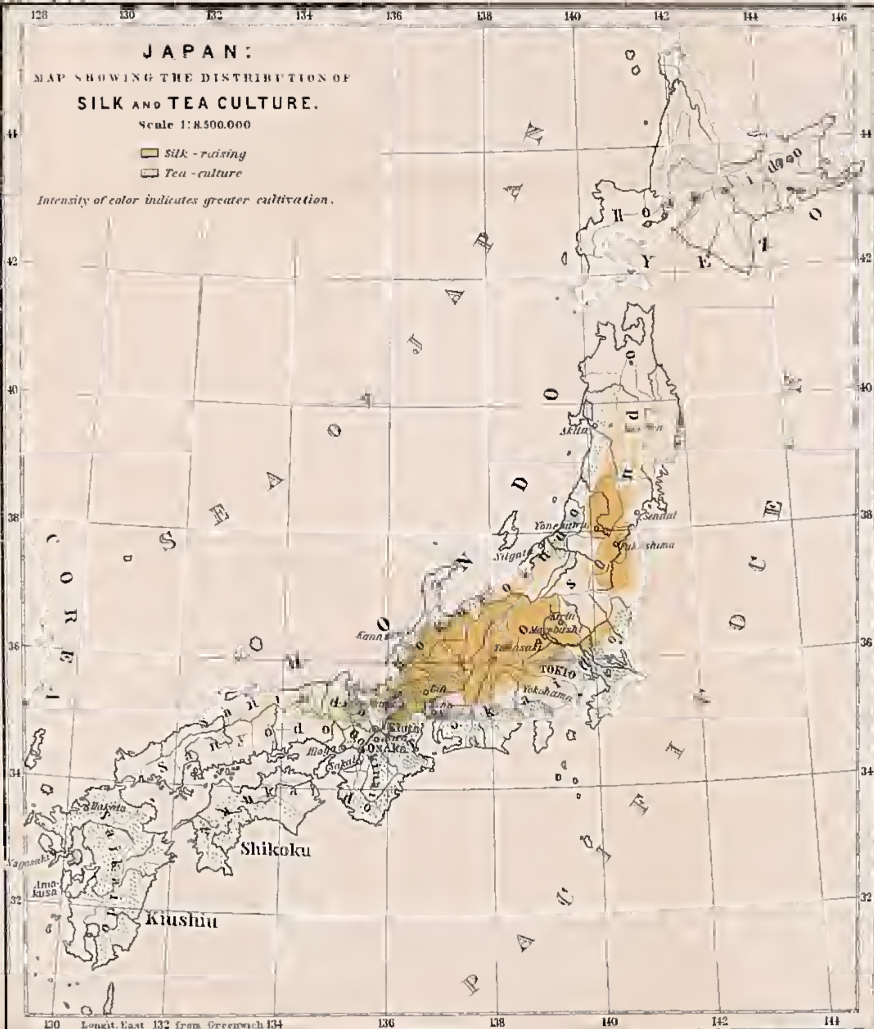
Export.				Import.			Balance.
Year.	Gold.	Silver.	Total.	Gold.	Silver.	Total.	— Export. + Import.
1872	2,684,786	1,796,109	4,480,896	—	3,691,510	3,691,510	— 798,386
1873	2,614,055	2,508,872	5,122,927	2,013,907	1,066,635	3,080,542	— 2,042,386
1874	8,126,290	5,868,912	13,995,202	2,700	1,069,031	1,071,731	— 12,923,471
1875	10,603,345	4,060,626	14,663,971	26,515	271,807	298,322	— 14,365,649
1876	5,872,356	4,803,345	10,675,701	721,465	7,545,776	8,267,241	— 2,408,460
1877	6,221,777	3,219,494	9,441,271	162,281	2,011,218	2,173,499	— 7,267,772
1878	4,601,083	3,727,570	8,328,653	243	2,188,858	2,189,101	— 6,139,551
1879	4,749,635	8,029,229	12,778,864	731,666	2,403,138	3,134,804	— 9,644,060
1880	5,888,174	7,334,819	13,222,993	20,618	3,617,612	3,638,230	— 9,584,763
1881	2,246,889	5,243,658	7,490,547	150	1,855,997	1,856,147	— 5,634,401
1882	1,251,035	3,179,162	4,430,198	500	6,160,224	6,160,724	+ 1,730,527
1883	1,009,570	2,146,995	3,156,565	559	5,450,942	5,451,501	+ 2,294,935
1884	1,423,654	3,581,418	5,005,072	299,202	5,312,557	5,611,759	+ 606,687
1885	492,636	3,763,809	4,256,446	608,813	6,938,028	7,546,841	+ 3,290,396
Total	57,785,285	59,264,018	177,049,306	4,588,619	49,583,333	54,171,952	— 62,886,454
Average	4,127,520	4,233,144	8,360,665	327,758	3,541,667	3,869,425	— 4,491,890

Summary of the most Important Articles of Import since 1868, and their value in Yen.

Year.	Cotton Yarn and Stuffs.	Half-Woollen Goods.	Woollen Goods.	Metals.	Arms and Ammunition.	Petroleum.	Sugar.	Various European and American Goods.	Various Asiatic Goods.
	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.	Yen.
1868	4,722,583	—	2,610,838	693,780	2,730,651	—	345,267	1,491,045	2,751,476
1869	5,251,324	—	2,010,553	632,255	1,857,635	—	1,597,944	1,776,690	5,828,485
1870	7,274,453	—	1,995,364	320,681	206,908	—	2,482,293	3,231,007	2,083,460
1871	8,011,478	—	2,056,789	536,291	293,120	—	3,308,549	2,398,433	312,415
1872	10,065,155	1,237,166	6,335,014	416,642	83,617	89,694	2,266,880	1,600,233	1,026,666
1873	9,793,488	2,425,867	4,879,140	451,202	577,645	323,374	2,108,855	5,332,115	574,226
1874	9,108,750	1,730,525	1,588,896	1,131,185	20,885	292,646	2,579,406	3,642,626	1,155,656
1875	8,974,037	2,026,532	3,846,636	1,043,382	44,576	590,032	3,482,588	4,441,537	999,903
1876	9,052,708	840,561	3,444,494	948,652	51,959	455,792	2,743,820	4,021,959	947,953
1877	8,353,675	1,302,923	4,071,155	1,620,712	461,729	602,725	2,872,148	4,698,436	846,722
1878	12,739,219	1,156,906	4,636,752	1,888,006	296,878	1,856,881	3,073,242	6,144,012	759,049
1879	12,111,886	1,307,478	4,172,513	1,644,307	45,494	2,185,223	3,422,051	5,958,610	1,400,296
1880	13,443,808	1,881,770	4,212,377	2,153,872	191,378	1,400,378	3,619,001	3,787,162	5,638,017
1881	12,511,287	1,237,921	3,344,790	2,042,424	50,659	978,933	3,816,807	4,900,291	1,764,700
1882	10,852,742	1,011,225	1,838,588	1,949,903	178,660	2,330,905	4,529,639	6,146,332	954,248
1883	9,037,504	1,086,480	2,478,306	2,033,263	97,020	2,456,261	4,381,303	4,803,271	1,764,700
1884	8,200,745	534,311	2,966,706	2,054,689	201,749	1,773,361	5,953,466	5,330,067	971,587
1885	8,881,706	954,536	2,023,612	2,628,449	357,444	1,667,722	4,654,168	?	?

VIII. Imports of the most important goods, according to Countries and value in Yen, during the year 1885.

Goods.	England.	China.	India and Siam.	United States.	Germany.	France.	Belgium	Switzer-land.	Corea.	Italy.	All other Countries
Raw Cotton	—	750,120	58,928	—	—	—	—	—	23	—	—
Cotton Yarn	2,894,947	—	2,295,148	—	—	1,115	—	721	—	—	—
Shirting	1,463,931	—	273	3,907	29	1,461	—	—	—	—	6,428
Other Cotton Goods	743,762	440	882	6,567	6,333	5,292	—	19,065	384	—	482
Italian Cloth	801,721	—	—	1,419	8,249	18,085	—	—	—	—	—
Woollen Cloth	234,413	—	—	50	131,636	14,002	6,379	2,742	—	—	2,682
Muslin	4,574	—	—	—	183,165	716,152	2,726	—	—	—	—
Flannel	51,208	—	—	58	218,054	17,862	—	—	—	—	—
Woollen Blankets	201,641	—	—	105	5,259	152	—	715	—	—	—
Half-silk Fabrics	15,171	—	—	—	239,849	81,615	—	73,659	—	—	—
Articles of Clothing	248,602	5,895	939	19,761	56,557	24,986	—	1,804	—	7,432	934
Sugar	—	2,080,756	69,536	9,912	392	3,567	—	—	26	—	—
Rice	—	114,334	532,789	—	—	—	—	—	27,201	—	—
Wine	8,853	10	—	3,273	4,094	89,485	615	313	—	458	2,848
Beer	47,692	423	—	5,872	41,697	3,329	337	—	—	—	21,750
Other Provisions	58,495	57,155	11,887	214,153	10,281	21,036	621	12,075	31,215	3,194	10,152
Iron	1,491,194	89	—	11,901	114,495	29,853	182,471	448	—	7,134	—
Steel	216,207	—	—	10	8,987	5,717	2,184	1,904	—	—	2,002
Other Metals	334,979	8,890	5,978	24,614	17,735	13,053	8,225	125	731	—	15,731
Arms and Ammunition	155,468	—	—	138,003	85,139	580	—	1,404	—	—	—
Instruments	81,360	1,101	—	28,528	24,477	19,675	452	7,100	—	30	260
Machines	486,089	—	—	39,917	34,503	25,092	2,262	2,758	20	9,163	1,200
Clocks	—	—	—	122,015	353	—	—	731	—	—	—
Watches	3,164	—	—	11,867	515	3,042	—	156,974	—	—	—
Books and Writing Material	120,597	51,707	753	68,697	38,212	6,630	1,423	224	50	75	881
Glass and Glass Goods	35,057	505	16	3,686	24,249	3,152	91,149	269	—	4,491	1,217
Leather	858	89,629	112,111	172,707	9,704	8,329	1,750	320	—	—	501
Tortoise-shell and Coral	17,345	4,670	47,371	—	—	—	—	—	—	44,085	18,703
Drugs	335,940	114,968	56,951	36,652	84,181	39,872	505	—	12,789	5,138	24,726
Dye Stuffs	162,035	85,753	12,288	2,254	122,582	26,105	4,651	22,421	3,127	1,234	40
Petroleum	—	—	—	1,667,722	—	—	—	—	—	—	—
Other Imports	2,200,119	2,396,605	191,114	202,535	194,926	150,617	11,933	483	163,740	13,562	138,482
Total Import	12,415,422	5,763,050	3,396,965	2,796,185	1,665,653	1,329,866	317,683	306,255	239,315	95,996	249,019
Percentage of Total Import	43·8%	20·2%	11·9%	9·8%	5·8%	4·7%	1·1%	1·1%	0·8%	0·3%	0·5%



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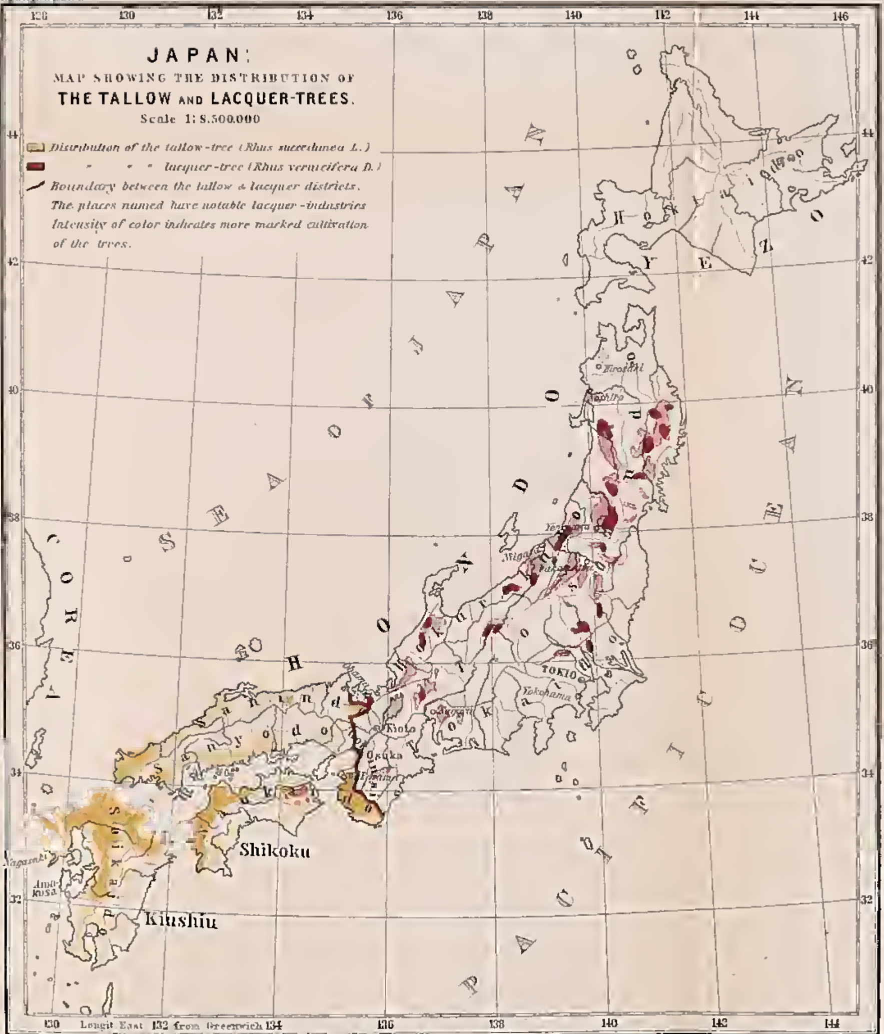
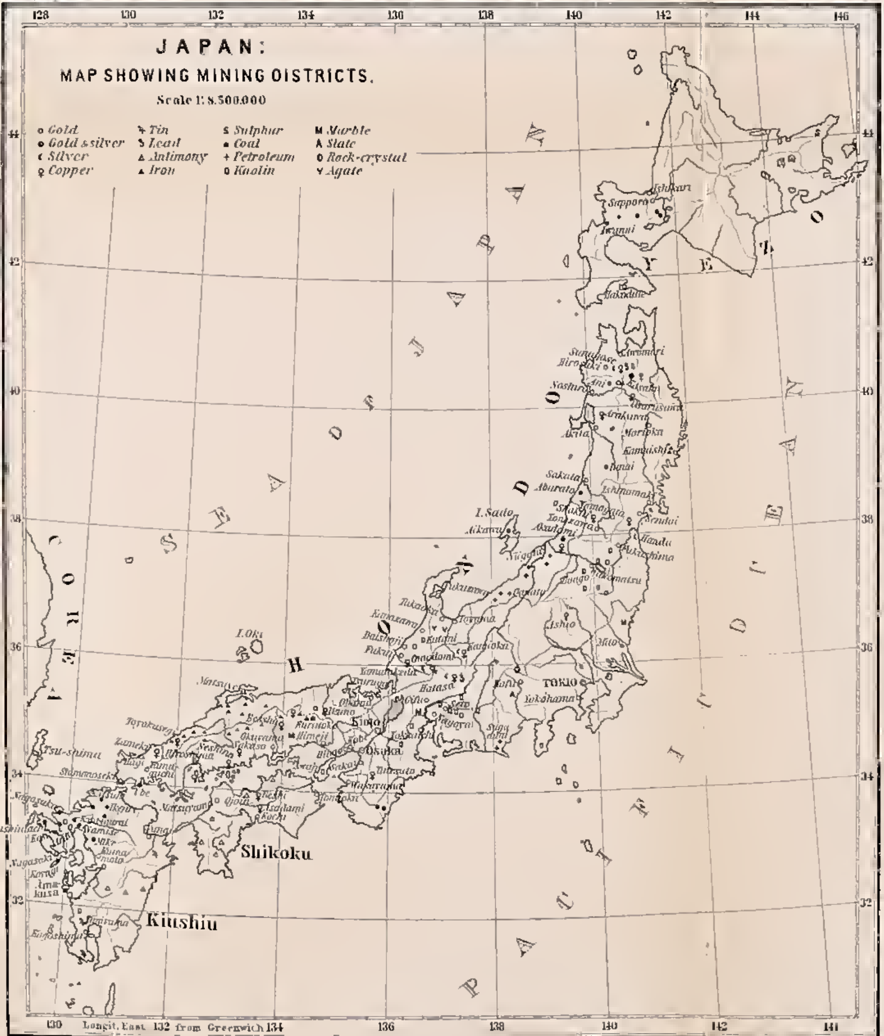

JAPAN:
MAP SHOWING THE DISTRIBUTION OF
THE TALLOW AND LACQUER-TREES.
Scale 1: 8.500.000
Distribution of the tallow-tree (Rhus succedanea L.)
" " " lacquer-tree (Rhus vernicifera D.)
Boundary between the tallow & lacquer districts.
The places named have notable lacquer-industries
Intensity of color indicates more marked cultivation of the trees.
SEA OF JAPAN
PACIFIC OCEAN
COREA
YEZO
Hirosaki
TOKIO
Yokohama
Kioto
Osaka
Nagasaki
Amakusa
Shikoku
Kiushiu
Longit. East 132 from Greenwich 134
Wagner & Debes, Leipzig



Geograph. Anstalt von
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II. INDEX OF JAPANESE NAMES.

In writing Japanese names the prevailing phonetic method, as given in Hepburn's Dictionary, has been generally followed. According to this the vowels are pronounced clear—as in German—like *ai*. Further, *ei* as *e*, *ch* as *tsch*, *j* as *dsch*, *s* sharp, *sh* as *sch*, *ts* as *z*, *z* as *s*, *y* as *j*. *ai*, *ei* and *ô* from a precedent contraction are long. On account of the accent many compound words are divided by hyphens, which are often written without them. As a rule the accent falls on the first syllable—as well on the first as the concluding word, with a somewhat stronger accent on the first full-toned syllable. The commonly joining particle "*no*" is half-tone. A declination of the accent is marked with an acute. Ho-no-ki is read as Hónoki, Tsubáki-no-abura as Tsubáki-noábura, Hasú-no-hana as Hásunohánna, Nikkei as Níkké, Mei-butsu as Mébútsu.

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